

## FEDERATED MALAY STATES.

### MEDICAL REPORT FOR THE YEAR 1920.

#### VITAL STATISTICS.

The estimated population for the year was 1,351,541. The estimated population for the Federated Malay States for the past ten years is shown thus:

1911	...	...	...	...	...	...	...	1,045,947
1912	...	...	...	...	...	...	...	1,081,799
1913	...	...	...	...	...	...	...	1,117,625
1914	...	...	...	...	...	...	...	1,136,500
1915	...	...	...	...	...	...	...	1,172,336
1916	...	...	...	...	...	...	...	1,208,177
1917	...	...	...	...	...	...	...	1,244,018
1918	...	...	...	...	...	...	...	1,279,859
1919	...	...	...	...	...	...	...	1,315,700
1920	...	...	...	...	...	...	...	1,351,541

#### BIRTHS.

Thirty-six thousand five hundred and fifty-six births were registered during the year giving birth-rate of 27.05 per mille population:

Year.							Births.	Birth-rate per mille.
1911	...	...	...	...	...	...	20,310	19.41
1912	...	...	...	...	...	...	25,426	23.50
1913	...	...	...	...	...	...	26,349	23.05
1914	...	...	...	...	...	...	27,978	24.61
1915	...	...	...	...	...	...	29,699	25.33
1916	...	...	...	...	...	...	29,337	24.20
1917	...	...	...	...	...	...	34,763	27.94
1918	...	...	...	...	...	...	33,011	25.70
1919	...	...	...	...	...	...	32,325	24.57
1920	...	...	...	...	...	...	36,556	27.05

#### DEATHS.

Forty-three thousand seven hundred and five deaths were registered giving a death-rate of 32.34 per mille:

Year.							Deaths.	Death-rate.
1911	...	...	...	...	...	...	40,914	39.11
1912	...	...	...	...	...	...	40,901	37.08
1913	...	...	...	...	...	...	38,000	34.00
1914	...	...	...	...	...	...	39,003	34.31
1915	...	...	...	...	...	...	33,899	28.92
1916	...	...	...	...	...	...	36,981	30.06
1917	...	...	...	...	...	...	42,514	34.17
1918	...	...	...	...	...	...	67,639	52.85
1919	...	...	...	...	...	...	38,645	29.37
1920	...	...	...	...	...	...	43,705	32.34

#### CHIEF TOWNS.

The subjoined table sets out the estimated population and death-rate per mille of the principal townships during the past seven years:

Year.	Kuala Lumpur.		Taiping.		Ipoh.		Seremban.	
	Population.	Death-rate.	Population.	Death-rate.	Population.	Death-rate.	Population.	Death-rate.
1914 ...	58,107	33.88	20,992	46.63	27,675	30.08	10,617	63.76
1915 ...	59,727	27.83	21,615	33.99	28,796	27.08	11,007	47.15
1916 ...	61,443	27.73	22,237	36.00	29,913	30.15	11,397	52.55
1917 ...	63,064	28.54	22,859	31.00	31,032	32.67	13,620	55.35
1918 ...	64,686	38.34	23,481	41.61	32,150	35.92	14,544	45.38
1919 ...	66,308	26.36	24,721	37.45	33,238	23.56	14,544	45.38
1920 ...	67,920	30.00	25,434	39.90	34,357	22.64	15,006	34.05



The infantile mortality in the native States is painfully high. It is due to improper feeding, neglect of sick children and ignorance on the part of the mothers. A scheme for dealing with this matter is under consideration but until the Health Branch is fully staffed little can be done. Crèches should be established on all estates under the care of trained Ayahs. The diseases which caused the greatest number of deaths were malaria, dysentery, diarrhoea, pneumonia and pulmonary tuberculosis.

The following table shows the deaths and the death-rate from the principal diseases for the last ten years :

Year.	Malaria.		Dysentery and diarrhoea.		Pulmonary tuberculosis.		Beri-beri.	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.
1911 ...	17,440	17.47	7,659	7.31	2,300	2.20		
1912 ...	17,870	16.52	5,885	5.44	1,353	1.25	1,212	1.12
1913 ...	16,414	14.69	5,317	4.75	1,623	1.45	1,190	1.06
1914 ...	13,634	11.99	5,235	4.60	1,655	1.45	1,223	1.07
1915 ...	15,208	12.97	3,148	2.68	1,995	1.70	871	.74
1916 ...	17,627	14.58	3,197	2.64	2,193	1.81	757	.62
1917 ...	18,750	15.07	4,942	3.97	2,446	1.96	1,207	.97
1918 ...	31,515	24.62	4,280	3.34	3,184	2.48	1,277	.98
1919 ...	16,975	12.90	3,712	2.82	2,445	1.86	939	.74
1920 ...	20,595	15.24	3,804	2.81	2,634	1.95	431	.32

#### PRINCIPAL DISEASES IN HOSPITALS.

*Malaria* shows an increase of 3,620 deaths and the death-rate is higher by 2.34 per cent.

The causes of this increase are probably two-fold:

- Improved diagnosis of the disease in the hospitals by microscope examination, obscure conditions of malaria being more often recognized coming under their proper heading;
- Reports made at Police stations of persons dying of "*deman*" are usually recorded as malaria yet many of these cases are puerperal fevers, pneumonias, bacillary dysenteries and so forth.

Qualified members of the medical staff inspect dead bodies but in outlying regions this is not practicable and errors as to the cause of death are common.

Travelling dispensaries, Ford ambulances well equipped, visit the villages of the various States and distribute quinine. They have proved a great success and their numbers have been increased. Penghulus, Police stations and post offices are supplied with quinine through the Health Department, and now that the distribution is properly organized, it is hoped to increase the amount supplied.

The risk of cerebo-spinal fever being mistaken for malaria should not be lost sight of. The work of prevention of malaria has been vigorously taken in hand and reorganized.

The Malaria Advisory Board has received a new lease of life and its members are largely experts.

As soon as the financial conditions permit and the Health Department is fully staffed a bigger programme of work will be possible.

It has been customary in the press to compare the conditions of Panama with those obtaining here.

It must be pointed out that only the towns and a narrow strip of country along the canal bank have been dealt with, and malaria still occurs even in the protected areas in the Canal Zone.

Malaria was declared a notifiable disease in certain places during 1920. This proved a success in some regions but in others the apathy of the public caused to fail. Probably when the system is better known it will be effective everywhere.

*Influenza*.—There were numerous cases of a mild type, and some of a very fatal kind. Influenza will probably be endemic in Malaya.

*Ankylostomiasis*.—The American Commission of enquiry proved that 95 per cent. of the population were infected yet the death-rate is only .44 per mille.

The Senior Health Officer does not regard the disease as a serious menace to health unless complicated with malaria or some other disease.



Measures have been taken to sterilize carriers of the worm before they enter the country. Several cases of poisoning after doses of chenapodeum oil have been noticed and it is a drug which should be cautiously used.

*Phthisis*.—Since the Malays became rubber planters, many of them abandoned the old attap type of house for poorly designed, ill-ventilated and overcrowded wooden buildings. This accounts for the regrettable increase of phthisis amongst them.

Overcrowding and dirty habits are the primary causes of phthisis among the Chinese and Tamils. It is very rare to see any native patient in time to do any good.

Tuberculosis of bone seems slightly more common than formerly. Tuberculosis should be declared a notifiable disease. Sanatoria for Malays and other races are proposed. The Sanitary Board By-laws against dirt should be strictly enforced.

*Enteric*.—While remarkably free from enteric a few cases do occur amongst all races and careful diagnosis is needed to detect them amongst natives.

*Dysentery and Diarrhoea*.—The diagnosis of dysentery has been improved and the dysentery, which used to cause many deaths and filled the hospitals of the Perak gaols, has disappeared after close attention was paid to the prevailing conditions.

#### GAOL.

The following table gives the average daily sick and percentage of sick to strength for the last six years and shows a further decrease in the sick-rate.

Year.					Average daily strength.					Average daily sick.					Percentage of sick to strength.
1915	...	...	...	...	766.93	...	34.37	...	4.18						
1916	...	...	...	...	704.00	...	37.81	...	5.37						
1917	...	...	...	...	632.91	...	29.19	...	4.61						
1918	...	...	...	...	531.81	...	12.92	...	2.42						
1919	...	...	...	...	584.90	...	13.09	...	2.22						
1920	...	...	...	...	580.90	...	10.67	...	1.83						

In Batu Gajah, no case has occurred for two years.

#### DYSENTERY.

Year.					Total treated.					Deaths.					Percentage of death to total treated.
1915	...	...	...	...	130	...	25	...	19.23						
1916	...	...	...	...	90	...	17	...	18.88						
1917	...	...	...	...	102	...	17	...	16.66						
1918	...	...	...	...	35	...	3	...	8.57						
1919	...	...	...	...	54	...	5	...	9.25						
1920	...	...	...	...	7	...	1	...	14.28						

More common type of bacillary due to Flexter's Shiga's bacilli.

*Venereal Diseases*.—These are still a scourge and they are extremely difficult to deal with owing to the ignorance and hostility of the native population.

In places dispensaries are now open where the out-door treatment of venereal disease is given special attention, it is hoped to add to their numbers in the future.

The treating of these diseases by chemists and quacks leads to lamentable results.

A campaign against venereal disease with education and literature may effect some good.

Large quantities of novarsenobenzol have been used with good results in syphilis and yaws. The danger of the drug must be borne in mind. In the army persons receiving doses are kept in bed for two or three days before and after the injection. Indiscriminate use of the drug without careful examination of the patients may lead to fatal cases of poisoning.

*Infectious and Contagious Diseases*.—There was a severe epidemic of small-pox in Perak with 155 deaths. These cases were almost entirely among Malays. Neglect of vaccinations in the past being the main factor, but the hostility of the Malay population and their disregard of the most elementary precautions had much to do with prolonging the outbreak.

*Beri-beri*.—As the Senior Medical Officer, Selangor, points out the control of rice led to the introduction into the country of Rangoon and parboiled rice.

The result on beri-beri may be judged by the following figures: Perak, 98 cases; Selangor, 260; Negri Sembilan, 87; Pahang, 7, against hundreds in each State with a high mortality in former years.

It is possible that the consumption of other cereals in place of rice also favourably effected the population. The figures lead one to think that the introduction of polished rice should be forbidden in view of the loss of life and money involved.



*Scurvy*.—It has not been generally recognized that a mild form of scurvy is prevalent among many of the pauper patients who come to hospital. It generally does not go beyond the early stages but occasionally advanced cases are seen usually in the vagrant wards and gaols.

The army commission on scorbutic conditions reports that to avoid scurvy one pound of fresh green vegetable should be issued daily to each soldier. Our best diet contains only six and a half tahils of cooked vegetables per day.

This is not enough, and lime juice, oranges and bananas are issued as an extra in certain cases.

Reports received from hospitals adopting the issue of fruit are favourable and it is eagerly asked for.

*Cholera*.—Three immigrant ships arrived infected with cholera with 14 deaths; all in Selangor Quarantine Camp.

*Plague*.—There was one death from plague in Selangor.

*Cerebro-Spinal Meningitis*.—"Spotted fever." There were ten deaths from this cause in Perak, twelve in Selangor and one in Pahang.

The greatest care should be exercised in the diagnosis of this disease as it is easy to confound it with other conditions.

The incubation period not being accurately known quarantining contacts is difficult.

#### OPERATIONS.

							Major.		Minor.
Perak ...	...	...	...	...	...	...	407	...	1,866
Selangor ...	...	...	...	...	...	...	273	...	2,859
Negri Sembilan ...	...	...	...	...	...	...	143	...	1,400
Pahang ...	...	...	...	...	...	...	31	...	224

#### SURGERY.

Eight hundred and fifty-four major operations were performed during the year and 6,349 minor.

The surgical work shows distinct improvement and in spite of being overworked, the results have been such that the surgeons may be congratulated on their performances.

The most serious operations in surgery were undertaken with almost uniform success.

#### RADIOLOGY.

The work of the X-Ray department was handicapped throughout the year by the lack of any expert. A Radiologist is now in charge and with somewhat antiquated apparatus extraordinarily good work has been done. New and up-to-date apparatus is on order.

#### MEDICAL INSTITUTIONS.

		Hospitals.		Gaol hospitals.		Lunatic asylum.		Leper asylum.		Estate hospitals.
Perak ...	...	22	...	3	...	1	...	2	...	2
Selangor ...	...	14	...	1	...	1	...	—	...	—
Negri Sembilan ...	...	7	...	1	...	—	...	—	...	—
Pahang ...	...	5	...	2	...	—	...	—	...	1
Total ...	...	48	...	7	...	2	...	2	...	3

#### MALAY WOMEN'S HOSPITALS.

Lady medical officers are stationed at Kuala Kangsar, Kuala Pilah and Pekan.

These ladies have performed good work under trying and too often disheartening conditions.

In Pekan the Malays are particularly difficult to treat. An officer whose knowledge of the Malays is second to none said "you need not expect much success with the present generation. The children now at school will be more easy to reach and the third generation will believe in western medicine."

This officer seems correct to judge by the figures of this and past year, yet the numbers of admissions are slightly increasing.

#### MALAY HOSPITALS FOR MEN.

The Malay hospitals at Kuala Kangsar has not proved popular yet the figures show an increase. The total number of Malays treated as in-door patients at all the hospitals has also increased. During 1919, there were 1,301 patients admitted and 1,848 during 1920.

In treating the Malays the personal equation and luck are important factors.

If a doctor happens to have a success or two amongst the Malays, he gains their confidence, if he is so unfortunate as to get hopeless cases at first he can do little or nothing afterwards.



## IN-DOOR PATIENTS.

During 1920, 120,879 patients were treated in-door as against 99,829 during 1919, but death-rate is lower in the case of each State. In Perak, the death-rate was only 7.60 against 9.36 the year before.

## OUT-DOOR PATIENTS.

The figures for 1920 are 275,783 as against 241,682 for 1919. This remarkable increase of 32,101 is due to the admirable work of the motor ambulances which visit the villages, and a further increase is to be expected. In Perak, the number of new cases treated by the ambulances was 10,922.

## LEPER ASYLUMS.

There were 835 lepers in the three Asylums. Endeavours have been made to improve the lot of these unfortunate people, and the proposals for a new asylum are under consideration.

## VACCINATIONS.

There were 218,320 persons vaccinated during 1920 while the figures for 1919 were 136,515.

In Perak, 142,221 persons were vaccinated as against 59,033 during 1919. These figures give an idea of the works performed by the staff during the small-pox epidemic.

Vaccination has not been systematically carried out in the past but the system has been reorganized.

## QUARANTINE CAMP, PORT SWETTENHAM.

Forty-seven thousand, five hundred and sixty-one immigrant coolies passed through the camp as compared with 52,250 last year a decrease of 4,689. The daily average number in camp was 1,097. Six thousand two hundred and seventy-eight cases were treated in the camp hospital. The daily average sick was 137.97.

Three immigrant ships arrived infected with cholera and out of 32 cases, 14 proved fatal.

## SMALL-POX.

No ship arrived infected with small-pox and no cases occurred in the camp.

Thirty-five absconded from the camp compared with 156 last year. Three thousand, three hundred and thirty-two patients attended the dispensary at Port Swettenham.

## ESTATE STATISTICS.

Returns were received from 1,156 estates. Besides these, there are many small estates of less than 100 acres each which did not send returns. The 1,156 estates were distributed as follows:

Perak	...	...	...	...	...	...	...	...	546
Selangor	...	...	...	...	...	...	...	...	349
Negri Sembilan	...	...	...	...	...	...	...	...	231
Pahang	...	...	...	...	...	...	...	...	30

Total average number of labourers was 235,156.

Total average number of Indians was 161,068.

## METEOROLOGY.

*Taiping*.—The highest temperature recorded was 94°; the lowest, 68°. The total rainfall for the year was 4,086 mm.

## SELANGOR.

Highest temperature: Rawang, 104°; lowest, Kuala Kubu, 64°.

Rainfall: highest, Prisons, Kuala Lumpur, 3,001 mm.; lowest, Kuala Selangor, 1,571 mm.

## NEGRI SEMBILAN.

Highest temperature: Kuala Pilah, 99°; lowest, Jelebu, 64°.

Rainfall: highest, Port Dickson, 2,011.90 mm.; lowest, Kuala Pilah, 1,395.7 mm.

## PAHANG.

Highest temperature: Kuantan, 99°; lowest, Kuantan, 62°.

Rainfall: highest, Kuantan, 2,787.40 mm.; lowest, Bentong, 1,375 mm.

## VETERINARY BRANCH.

## RINDERPEST.

*Selangor*.—On eight occasions, rinderpest developed in bullocks recently imported from India, West Siam and Singapore with a total of 27 cases and 14 deaths—all contacts, 280 were inoculated with serum as soon as possible and in no case did the disease spread outside the quarantine stations.

*Negri Sembilan*.—An outbreak of this disease was detected in quarantine station, Seremban and Port Dickson from cattle imported from Singapore, and simultaneously an outbreak occurred in Tampin district in a wide area bordering to Kuala Pilah district. Eighty-six cattle and 34 buffaloes in all became infected, of which 56 cattle and 32 buffaloes died, 246 cattle were inoculated with serum, of the selected animals 56 developed disease and 38 died.



## SURRA.

*Perak.*—Four cases of this disease occurred in the district of Krian among ponies, during the year one died and three were destroyed, the owners being compensated to the extent of half the value of the ponies.

*Negri Sembilan.*—Eight cattle were destroyed as affected from Surra in Jemima Estate, Coast district, the blood of those examined being found to be swarming with trypanosomes.

## FOOT-AND-MOUTH DISEASE.

*Perak.*—Foot-and-mouth disease occurred in Krian, Larut and Matang, Kuala Kangsar and Upper Perak districts during the year. The first outbreak occurred in Parit Buntar in April from cattle imported from Penang, the disease later spread to Kuala Kangsar and Bagan Serai. Altogether there were 316 cases with 12 deaths. In June, an outbreak occurred in Larut district where there were 289 cases with three deaths. In July, it also appeared in Kuala Kangsar district where there were 304 cases with no deaths, it spread to Lenggong in July where there were 123 cases with no death. There were, therefore, 1,032 cases of the disease with 15 deaths during the year.

*Negri Sembilan.*—This disease occurred in all the districts from time to time from January to December and was of the usual mild type; total cases 780 with three deaths.

## SWINE FEVER.

In July, seven pigs were found affected with swine fever at Taiping, by timely reporting and enforcing strict quarantine it was possible to suppress the disease without any further spread.

*Selangor.*—Pleuro-pneumonia of goats: six cases were reported, five died and one was destroyed. The origin of this outbreak which occurred at Sungei Besi could not be traced.

## RABIES.

There were seven cases with six deaths and one destroyed amongst dogs, six of these cases occurred in Kuala Lumpur and one at Kuala Selangor, all were confirmed by the examination of the brain at the Institute for Medical Research.

## QUARANTINE STATIONS.

*Port Swettenham.*—Two thousand, four hundred and fifty bullocks, 5,578 buffaloes, 3,888 sheep and goats, 11 horses and ponies, 29 dogs and 483 pigs were dealt with at this station—total 12,430 animals. There were 97 deaths.

*Bukit Sentel.*—Eight hundred and thirty-seven cattle were quarantined in this station and only one death occurred.

*Negri Sembilan.*—Seremban Cattle Quarantine Station: Two hundred and eighty-two buffaloes and 80 cattle were quarantined in this station.

*Pahang.*—Throughout the year Pahang has been free from outbreak of contagious diseases amongst animals.

## POLICE CASES.

	Cases.	Convictions.	Fines.
Perak ... ..	637	620	\$7,729.75
Selangor ... ..	476	442	2,957.00
Negri Sembilan ... ..	296	290	4,770.50
Pahang ... ..	95	90	698.50
	<hr/> 1,504	<hr/> 1,442	<hr/> \$16,155.75

## FINANCE.

The total revenue collected during the year was as follows:

	1920.	1919.
Perak ... ..	\$96,498.69	\$79,462.78
Selangor ... ..	78,356.37	51,842.80
Negri Sembilan ... ..	32,272.19	19,133.82
Pahang ... ..	10,613.66	6,585.98
	<hr/> \$217,740.91	<hr/> \$157,025.38

The total expenditure under personal emoluments and other charges amounted to \$3,873,236.84.



## STAFF.

It is with the deepest regret the death of Dr. J. R. Delmege, Health Officer, Seremban, is recorded. The late Dr. Delmege was extremely popular and had long service in Government.

Throughout the year the staffs were far under the authorized establishments.

Several private practitioners were engaged locally with good results. The Health Department for the greater part of the year consisted of only five Health Officers and the Senior Health Officer.

Comment is unnecessary, it was impossible to do the work properly.

Conditions are now improving somewhat.

## APPOINTMENTS.

The following officers were appointed during the year: Dr. W. J. Symes, 9th July, 1920; Dr. R. W. Cilento, 25th October, 1920; Dr. W. F. MacDonald, 15th August, 1920; Dr. H. M. Harrison, 7th December, 1920; Dr. H. Mowat, Radiologist, December; Dr. C. E. Cobb, Mrs. Cobb, L.M.O., Dr. Jackson and Dr. J. Brown.

## SISTERS.

Miss A. Campbell, E. M. Earps, J. Leslie, A. Boyd, A. Spence, A. Wood, M. Millard, K. Carr, F. Brazier, D. Abson, Dunsmore, Thomlinson, Webster, Seaman, Wright, Rose, and Fisher. Miss Bagley was transferred from Hongkong.

*Resignations.*—Dr. R. Bruce Low, on 6th May, 1920; Miss A. Jennings, 10th October, 1920; Miss E. M. Earps, 7th December, 1920; F. Brazier, 18th December, 1920 and Mrs. Baldie was invalided home.

The following officers were on leave: Dr. S. C. G. Fox, Dr. W. F. Samuel, Dr. D. M. Ford, Dr. H. G. Holdbrook, Mr. P. G. Short, Miss V. E. H. Foley, Miss M. A. Ford, Dr. E. A. Smith, Dr. A. A. Woods and Dr. I. P. Masters.

The following reports are attached as appendices:

A—Report of the Acting Government Entomologist;

„ Executive Engineer, Malaria Advisory Board.

The work of this department was extremely valuable and will prove of the greatest practical use.

B—Report of the Director of Government Laboratories:

The work has enormously increased and the staff was shortbanded during the year, nevertheless the most useful work was performed by the Director, Bacteriologist and Chemists under great difficulties.

C—Excerpts from the Senior Health Officer's report:

The report which is full of interest is too long to print fully. Considering the paucity of the staff the Health Department has done extremely well and has got through great deal of work.

D—Report of the Medical Superintendent, Central Asylum:

This admirably managed institution was conducted with its usual success throughout the year under review.

## GENERAL.

There are now eighteen Ford ambulances doing travelling dispensary work.

Five Sunbeam ambulances for moving first class patients are expected to be available shortly.

Two motor ambulance boats are on order. They will be placed on the Perak and Pahang Rivers and are an urgent need, especially for work among Malays. A new European Hospital, and General Hospitals are in the course of construction at Kuala Lumpur, they will be fitted with the most modern apparatus.

Other hospitals and buildings have to be postponed owing to financial reasons.

The training of Government and Estate Dressers will be eventually undertaken in Kuala Lumpur.

At present all that can be done is to improve the teaching in the various hospitals and to reorganize the examinations. This very important subject is receiving close attention.

KUALA LUMPUR.

R. DOWDEN,

*Acting Principal Medical Officer, F.M.S.*



## MALARIA BUREAU ANNUAL REPORT, 1920.

STAFF.

The subordinate staff at the beginning of the year consisted of:

Two laboratory assistants, class I;

Five " " " II;

Seven collectors :

One librarian :

One clerk ;

Two gardeners ;

One peon.

Towards the end of the year it was found necessary to increase the number of collectors up to the maximum allowed, to cope with the systematic work in hand.

Dr. W. A. Lamborn, appointed as Assistant Medical Entomologist, assumed duty on 21st March, enabling Dr. Hacker, the Medical Entomologist, to proceed on leave on 9th May since which date he has been away.

Dr. Lamborn took over the field work in April and since the first week in May has been responsible for the administration of the Bureau and for the work carried out. It was largely hampered at first by the absence on leave of the two senior assistants, Mr. Ampalavanar, up to 6th August, and Mr. Rajamoney, up to 3rd September.

## EXPENDITURE.

The money passing through the office may be classified as follows:

SALARIES AND WAR ALLOWANCES—

Medical Entomologist	...	...	...	...	...	\$ 3,286.68*
Assistant Medical Entomologist	...	...	...	...	...	6,604.83
Staff	...	...	...	...	...	14,211.41

TRAVELLING EXPENSES—

Maintenance of car	...	...	...	...	...	...	1,068.21
Bicycle allowances	...	...	...	...	...	...	832.64
Fares and freight	...	...	...	...	...	...	75.05
Night allowances	...	...	...	...	...	...	192.35

OTHER EXPENSES—

Apparatus	...	...	...	...	...	...	†
Laboratory equipment		...	...	...	...	...	347.42
Equipment for field work, clothing, etc.				...	...	...	849.99
Library	...	...	...	...	...	...	6.61†
Office equipment	...	...	...	...	...	...	813.58
Postage	...	...	...	...	...	...	41.47
Upkeep of grounds	...	...	...	...	...	...	29.23
Electric light and water		...	...	...	...	...	128.00
Purchase of typewriter	...	...	...	...	...	...	210.00

Total	...	\$28,697.47
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## WORK DONE AND SUMMARY OF RESULTS.

The work undertaken by the Medical Entomologist during the four months prior to his departure was largely impeded by sickness, but it included a continuation of his experiments on oiling, a draft report on which, showing the conclusions arrived at up-to-date, was forwarded by him to the Principal Medical Officer.

The rest of the present report deals only with work carried out by the Assistant Medical Entomologist except in regard to the actual figures for the field work, with which are included those obtained by the Senior Officer up to the end of March.

## FIGURES AS TO FIELD WORK.

These are as follows :

Breeding places found and examined	...	...	...	...	332
Larvae identified microscopically	...	...	...	...	37,751
Adults bred out and identified	...	...	...	...	6,090
Adults caught in houses	...	...	...	...	8,993

\* Up to 9th May, 1920.      † No bills have yet been received.



## BREEDING PLACES.

Endeavours to establish some of the open country species *A. maculatus* and *A. rossi*, var. *indefinitus* in jungle, both by the transfer of ova and of young larvae to water there, failed. The disappearance of jungle anophelines from jungle breeding places as a result of clearing and the subsequent invasion of such places by open country species has of course long since been established. But an interesting concrete example was obtained by collecting from a pool in belukar, which was subsequently cut down. Between July and September seven collections from it had afforded no less than 793 larvae of *umbrosus*, and no others. The bush surrounding it was then partly cleared and within a few weeks *A. sinensis* and *A. barbirostris* appeared, the data for three collections in November being 126 larvae of *A. umbrosus*, 127 larvae of *A. sinensis* and 367 of *A. barbirostris*. The bush was then completely cleared and subsequent collections showed that large numbers of *A. sinensis* and *A. barbirostris* had entirely replaced *A. umbrosus*.

The entire absence in June and July of anopheline larvae in certain pools and ponds in which they were to be expected suggested an investigation as to the causes of their absence. No quality of the water seemed to account for it, and after various experiments the final conclusion was reached that it was due to the presence of a large number of various predaceous aquatic insects, all brought within a small compass by a gradual drying up of the pools. Some aquatic bugs, of the family *Belostomidae* and some larvae of *Neuroptera*, so far undetermined, occurred in large numbers, and on the mud round the margins were large numbers of the Anthomyid fly, Genus *Lispa*, described by Atkinson in Hongkong and by the writer in Central Africa as predaceous on mosquitoes and their larvae, and here again, as was determined in other situations, carrying on their useful work.

A study has been in progress of the conditions favouring the development in artificial breeding places of the various larvae usually found, with a view to the better understanding of the occasional presence of anopheline larvae therein.

In the case of *S. scutellaris* it may hinge on so small a factor as egg structure for it has been demonstrated that the ova of this species which are not furnished with floats, sink under quite a moderate shower of rain and do not then hatch, so that it is essential for the female to seek a well-sheltered place for her ova. Furthermore the larvae of *stegomyia* in moving water cannot avoid being swept away owing to the absence of caudal hooklets.

The presence of various anopheline larvae, *kochi*, *rossi*, var. *indefinitus*, *leucophyrus*, *barbirostris*, *sinensis*, has been studied in various artificial breeding places, but no final conclusion has been arrived at. It probably depends on the existence of a medium suitable for the development of algae and enough light for the growth thereof.

## ANOPHELINE LARVAE IN MOVING WATER.

The presence of the larvae of *A. aconitus* in the river at Kuala Lumpur has already been referred to by Dr. Hacker (Annual Report, 1918). A further investigation of the anopheline fauna of rivers was conducted, which showed that various other species, *A. barbirostris*, *A. sinensis*, *A. maculatus* and *A. leucophyrus* could be obtained there, whatever the force of the current. A study of the means whereby the larvae are able so to exist was accordingly carried out.

It was discovered that certain of the bristles in the caudal tufts are terminated by hooklets, usually six or seven on each side, wherewith the larva is able to attach itself to objects, and is so able to avoid being swept away and that these hooklets have their counterpart in the pupa. An interesting deficiency in this respect is exhibited by the larva of *A. asiaticus*, the bamboo breeder, which cannot need them. In this species the number of hooks is reduced to three on each side, terminating long filamentous bristles, a condition paralleled, as Professor Alcock has since written, in the case of the British species that breeds in holes in trees.

The hooklets are present both in stream breeders and those more commonly found in pools. The former usually feed while attached by them to objects, while the latter more often than not float free. In the larva of various species of *Culex* and those of *Stegomyia scutellaris* no hooklets occur, and these are unable to attach themselves to supports. The variation in habit may possibly have important bearing on the influence of oil as a larvacide.

Dr. Hacker has recorded (Annual Report, 1919) that an imperfect film may suffice to cause the death of anopheline larvae. As these tend to attach themselves to floating matter, this may include oil globules and objects round which oil tends to accumulate. But it has now been found that *stegomyia* larvae which are independent of supports and are aquatic breathers to a greater extent than the anophelines do not succumb to an imperfect film when the latter do. It has yet to be shown whether the larvae of different species such as exhibit a rather different attitude to supports on the surface perish, all to an equal degree under the circumstances. One would expect that they do not do so.

## ANOPHELINE FAMILIES BRED IN THE LABORATORY.

Considerable work has been done on the breeding of anophelines in the laboratory. This being the final test of species, it is hoped thereby to settle finally certain long-vexed problems of the systematics of anophelines, particularly in regard to the relative status of *A. rossi*, Giles and *A. rossi*, var. *indefinitus*, Ludl.: that of *A. sinensis* and its var. *peditaeniatus*: the relationship, if any, between *A. maculatus* and *A. karwari*, and various other points.



This investigation has further afforded ample data, hitherto largely lacking, as to the bionomics of all important anophelines, especially as to season of oviposition, ovipositing habit, reproductive capacity, factors influencing hatching of ova, factors influencing growth and development of larvae, duration and course of life history, proportion of sexes in families, etc.

The mass of anopheline material so obtained has, in addition, considerable scientific interest in that, in certain of the families is exemplified the hereditary transmission of small variations, an influence it is considered by some prominent biologists, largely involved in the evolution of species. To take two instances—a fairly large proportion of captured females of *A. aconitus* lack the first black palpal band; a recurrence of the defect characterizes a considerable number of the offspring bred from such females. A parent *A. rossi*, var. *indefinitus*, lacking the first black palpal band, afforded some offspring exhibiting a similar deficiency.

This, so far as one has been able to learn, is the first attempt to demonstrate in anophelines by the unassailable proof obtained by breeding, the tendency to variation which has been so amply proved in the same way in the case of other groups of insects, notably the lepidoptera.

The magnitude of the effort to obtain this material may be estimated by the fact that it has necessitated the care, day by day, of a succession of captive anophelines totalling no less than 1,352, each in a separate breeding cage, often for so long a period as two or three weeks before succumbing. The success met with may be gauged by the gradual rise in the number of adult offspring obtained, which, from two or three per cent. of the ova obtained during the earlier work, has latterly, risen to 90 per cent. in some instances so that one family of *A. rossi*, var. *indefinitus* is represented by no less than 130 imagos and several families of *A. maculatus*, total 70.

Of the 1,352 captive anophelines, 281 only afforded ova.

As a preliminary to breeding these anophelines, a study was made of the welfare of the different larvae in various alga-containing media whereby it was ascertained that the larvae of *A. maculatus* and *A. karwari* have a predilection for certain filamentous algae, particularly a *Spirogyra*, abundant in moving water such as these species favour but rapidly breaking up under laboratory conditions—that all species, except the jungle ones, can thrive in the laboratory on a species of flagellate protozoon, *Euglena viridis* (which Dr. Stanton kindly determined), and it seems probable that certain species, particularly *A. sinensis* and *A. barbirostris*, can thrive on a species of *Volvox*, at all events when it is immature and small enough for their consumption. The discovery of *Euglena* in enormously rich and almost pure culture, an organism which by virtue of its chlorophyll-content keeps water aerated and which lives for days in the laboratory, was indeed the secret of the success finally met with in the breeding experiments. While the open country anopheline larvae thrive on this organism, no success was obtained with jungle species except with *A. leucophyrus*, examples of which, brought in as small larvae, attained maturity when fed on *Euglena* in the laboratory. The other jungle larvae fed as greedily on the organism as *leucophyrus*, as evidenced by the amazing bulk of their excreta, but yet did not grow. On comparative examination of the excreta of *A. leucophyrus* and of *A. albotaeniatus*, var. *montanus* it was evident that whereas the former had digested most of this food, the latter had largely failed to do so, hence a probable explanation of the limitation of certain species to jungle, where a special food not available in the open may be found. Such few experiments as have been conducted tend to show that open air and sunlight do not make much difference to these jungle breeders. This interesting line of research in regard to the digestive powers of the various species of larvae was unfortunately soon hampered by the failure of *Euglena*.

#### ALGAL PERIODICITY.

The question as to the seasonal prevalence of algae as having some bearing on a corresponding prevalence of anophelines was suggested by the gradual decline in early December of *Euglena* which during the previous three to four months had flourished luxuriantly. It had previously been noted that the *Spirogyra* found in *maculatus* breeding places in the vicinity of Kuala Lumpur was unobtainable during August and it was only for the first time in December that the species of *Volvox* already alluded to was found, though hundreds of specimens of water had been examined. The surface alga found so abundantly on fish-ponds is not, so far as recollection goes, present in all months.

A more ample study of the seasonal prevalence of algae has therefore commenced, and attempts have been made to obtain laboratory cultures. Owing to limited knowledge of these organisms and the absence of literature dealing with them, the attempts have been largely abortive, but a small unicellular alga isolated from small muddy pool water thrived luxuriantly in a medium of thoroughly decomposed rice water and similarly afforded subcultures. It is suggestive that on this subculture the *A. rossi*, var. *indefinitus* was bred from egg to imago while a similar attempt with *A. maculatus* was unsuccessful, though a few larvae attained about half growth though very slowly.



## SEASONAL PREVALENCE OF ANOPHELINES.

The important question as to the seasonal prevalence of anophelines has been approached in several directions. The records accumulated as to oviposition by captive anopheline have been charted and show, for example, that the dominant species, *A. rossi*, var. *indefinitus* oviposited month by month from March to date. For this anopheline, there are no less than twenty-three records during August. In the case of a more important species, *A. maculatus*, the record fails only in September though this does not necessarily mean that oviposition ceased from the time being, since such data can have positive value only.

The subject has been further studied by the systematic collection of larvae from certain situations—a fish pond, a swamp, some running water—at intervals which have been regular during the last six months by a constant number of collectors for an equal period of time on each occasion. The larvae have been determined and the results charted for fuller study when more ample.

A point of some interest discovered is that, when in consequence of the drying up of pools during a season of drought, such as occurred in July, *A. rossi*, var. *indefinitus* is denied its favoured breeding places, an enormous increase of these larvae during the earlier rains took place in fish ponds in which as a rule the species occurs sparingly, the explanation being probably that pools had only thoroughly dried up late in the drought and that owing to the parched condition of the ground such rains were insufficient at that time to refill the hollows.

The question of seasonal prevalence was further studied by the systematic collection of adult anophelines in three situations, namely from boys quarters attached to a residence, from certain coolie lines and cattle sheds. These results also have been chartered for study in comparison with those obtained by larva collection. The ultimate comparison of findings with malaria curves should be interesting.

In connection with the question of seasonal prevalence it is noteworthy that though *Stegomyia fasciata* has been reported as a dominant species in the vicinity of Kuala Lumpur, in no single instance was it captured nor was it bred from among a total of about 3,850 mixed culicid larvae,\* obtained in seventy-four collections from artificial breeding places. These were mostly *S. scutellaris*.

## CERATOPOGON PARASITIC ON ANOPHELINES.

The habits of this little fly, which was first described by Dr. Stanton as attacking anophelines, have been under further investigation. It was found in nature to breed in small muddy pools from which on various occasions numerous pupae were obtained, and it has bred freely in the laboratory.

The parasites, sometimes two at a time, have been found firmly attached to the abdomens of anophelines replete with blood and it has been determined that their object is not so much to obtain the juices of the anopheline as to deprive it, by puncture of the stomach, of a portion of its ill-gotten meal.

## PROTOZOA DESTRUCTIVE TO THE LARVAE OF STEGOMYIA.

A discovery of some interest was that of protozoa responsible for the death of a large percentage of several batches of larvae of *stegomyia scutellaris*, a species which, in the vicinity of towns at all events, takes advantage largely of artificial breeding places. The protozoa which flourish in the tissues of the larva are of considerable size, and tend to congregate in enormous numbers in the tracheal gills. Their dispersal is effected by the dropping off, or rupture, of the gills one by one, as a result of which the larva dies, but death may take place before this happens.

Specimens of the protozoa, which the writer is confident are entirely different from those commonly seen in old and sickly larvae, whether of *stegomyia* or of anophelines, have been submitted with a short draft paper to the Director of the Imperial Bureau of Entomology, by whom they have been sent on to Dr. Keilin of Cambridge, an authority on such organisms, so that fuller information respecting them will be forthcoming.

## LARVAL COLOURATION.

The study of the factors influencing larval colouration more particularly in the case of *A. sinensis* has been taken in hand, for in nature the larvae of this species show a high degree of variation. The colour may be light or deep green, or deep black, with or without a longitudinal band, or transverse markings of a different colour, crimson, bronze, china-white. The usually accepted account has been that colour is dependent on the nature of the food but it is by no means altogether the case, and the investigation tends to show that the colouration is largely a reaction to environment. The results obtained up-to-date though fairly ample are neither uniform nor wholly conclusive.

\* 19th February, 1921, this species has now appeared.



## INFECTION EXPERIMENTS.

It was suggested many years ago by no less an authority than Schaudinn that there might be hereditary transmission of the malaria parasite from an infected anopheline to its offspring, but, so far as the writer has been able to ascertain, no experiments bearing on the question have been recorded. The possibility in regard to *A. maculatus*, the species considered as being the most important of the Malayan carriers, was therefore investigated.

Twenty-one families comprising 217 males and 256 females bred from captive females, some of which were subsequently found to be heavily infected with the malaria parasite, were dissected, all with negative results.

The work in this direction was greatly facilitated by the ready and valuable help of Dr. Stanton, to whom were submitted all specimens which the writer, owing to a much more limited experience, thought, presented unusual appearances.

A short series of biting experiments were carried out with certain of the anophelines, *A. aconitus*, *A. barbirostris*, *A. sinensis*, *A. ludlowi*, *A. fuliginosus* and are still proceeding.

The systematic dissection of captured anophelines has proceeded so far as other and more important work would allow, and, to date, such dissections total 1,491.

## LOCAL OUTBREAKS OF MALARIA.

Outbreaks of malaria at Carcosa, in the neighbourhood of the Agricultural Department and on Federal Hill were investigated more particularly with the object of testing the continued efficiency of the drainage schemes carried out by the Executive Engineer, Malaria Advisory Board, and with a similar object in view the ravines drained in the neighbourhood of the European Hospital were examined as to the presence of breeding places.

The blood examinations carried out in connection with such work reached a total of 497 with positive results in the case of 105.

## TYPE COLLECTION.

No new species were found to add to the type collection, but an attempt was made to find a method of mounting type insects more suitable for their indefinite preservation in the humid atmosphere of the Federated Malay States than the old one of impaling on a pin's point. For imagos the method now employed at the London School of Tropical Medicine, namely, the enclosure of the specimen in a cell of carbolized plasticene on a slide by means of a coverslip and sealed with Canada balsam, has been employed, and a long series representing most species, prepare some three months ago, have so far kept well.

For larvae and pupae several new methods of mounting, devised by the Assistant Medical Entomologist, have been on trial and one has now been adopted. It consists in the enclosure of the specimens in formalin solution on a slide in a cell made of thick Canada balsam over the top of which a thin ring of gold size has been brushed so as to ensure the adherence of a coverslip. This is subsequently sealed by a little more Canada balsam over which a final ring of enamel is painted.

Specimens so prepared are at the end of three months entirely satisfactory, and it is now to be anticipated that they will remain so in which case the method will have value also in respect of ticks, fleas, etc., creatures always difficult to keep for type purposes.

Complete sets, both of larvae and of imagos so mounted have been issued to the Acting Executive Engineer, Malaria Advisory Board, and to Dr. Howard of Seremban, and a large instalment of a third set have been prepared for the Health Department.

## PUBLISHED REPORTS.

Copies of the Malaria Bureau Reports, volume I, published late in 1919 were despatched to every medical practitioner in the country and there has been a considerable demand from estate managers and others so that in all 933 copies have been sent out.

Volume II of the reports is in process of preparation by the Medical Entomologist who has written that it will be in the printer's hands by the end of the year.

## GENERAL REPORTS DURING THE YEAR.

A draft report on oiling by the Medical Entomologist.

A paper on the "Structure and Function of the Caudal Tufts of Malayan Anopheline larvae" by the Assistant Medical Entomologist. This will be published in a forthcoming number of the bulletin of Entomological Research.

The draft of a short paper "On the occurrence of Protozoa pathogenic to the larvae of *Stegomyia*," submitted to the Director, Imperial Bureau of Entomology.

On a survey round European Hospital, Kuala Lumpur, 15th September, 1920 (by the Assistant Medical Entomologist).



On anopheline breeding places along railway line and European Hospital, 28th September, 1920, (by the Assistant Medical Entomologist).

On mosquito survey round quarters occupied by Acting Treasurer, No. 532, Federal Hill, 30th September, 1920 (by Assistant Medical Entomologist).

On an outbreak of malaria at Carcosa, 30th September, 1920 (by the Assistant Medical Entomologist).

On a blood examination of the Asiatic servants at Carcosa, 5th October, 1920 (by the Assistant Medical Entomologist).

On a survey for mosquito breeding places in the neighbourhood of Agricultural Department, 12th October, 1920 (by the Assistant Medical Entomologist).

On an anopheline survey of vicinity of European Hospital, 19th November, 1920 (by the Assistant Medical Entomologist).

On a mosquito survey at Federal Hill and its vicinity, 29th November, 1920 (by the Assistant Medical Entomologist).

#### MISCELLANEOUS REPORTS.

On a mosquito sent by District Officer, Tampin, 20th March, 1920 (by the Assistant Medical Entomologist).

On a mosquito sent by Medical Officer, Coast, caught at his bungalow, 6th April, 1920 (by the Medical Entomologist).

On flies caught at the Residency, sent by Senior Medical Officer, Perak, 10th April, 1920 (by the Medical Entomologist).

On mosquito larvae sent by Dr. Howard of Siliau, Negri Sembilan, 28th June, 1920 (by the Assistant Medical Entomologist).

On anophelines in Mr. Harrison's quarters, Petaling Hill, 11th August, 1920 (by the Assistant Medical Entomologist).

On a mosquito sent by Dr. Fletcher, 24th July, 1920 (by the Assistant Medical Entomologist).

On a survey round Mr. Dunsmore's quarters, 30th August, 1920 (by the Assistant Medical Entomologist).

On mosquitoes sent by Mr. Peskett from Sandakan, 13th September, 1920 (by the Assistant Medical Entomologist).

On mosquitoes by Mr. J. H. Keer, Kuala Lumpur, 15th November, 1920 (by the Assistant Medical Entomologist).

On a mosquito sent by Health Officer, Klang, 2nd December, 1920 (by the Assistant Entomologist).

On anopheline larvae sent by Executive Engineer, Malaria Advisory Board, 30th December, 1920 (by the Assistant Medical Entomologist).

W. A. LAMBORN,  
*Acting Medical Entomologist.*

23rd February, 1921.



**REPORT ON WORK DONE UNDER THE EXECUTIVE ENGINEER,  
MALARIA ADVISORY BOARD, IN THE YEAR 1920.**

SELANGOR.

KUALA LUMPUR.

1. (i) The extension of and improvement of the drainage work was carried out during the year. The most important works being—the completion of Z ravine; sub-soil drainage affecting the Leper Hospital; neighbourhood of cooly lines, Loke Yew Road; drainage of low area, Ceylon Lane; improvement of drainage of area between Gonggang Lane and Ampang Road; golf course area; surface drains to carry discharge from quarters and the completion of one of the ravines in Bangsa Estate near Public Works Department cooly lines and estate factory.

(ii) Expenditure on anti-malarial drainage to end of 1920 has been as follows:

Year.	Construction.	Maintenance.	Approximate area under maintenance at end of year.
1908-1911 ... ..	\$47,705	\$ 6,987	
1912 ... ..	37,527	5,560	1,300 acres
1913 ... ..	68,459	11,118	3,000 „
1914 ... ..	22,314	11,157	—
1915 ... ..	8,989	10,705	3,500
1916 ... ..	23,054	10,487	4,000
1917 ... ..	23,630	10,206	4,500
1918 ... ..	33,222	13,625	5,100
1919 ... ..	43,966	16,998	5,700
1920 ... ..	56,607	17,958	6,200
	<u>\$365,473</u>		

NOTES.—Extensions paid for from maintenance votes have been included under “construction.”  
The figures for 1920 do not include the loss on supplying rice to coolies.

(iii) The approximate drained area is 6,200 acres. The following lengths of drains have been made:

Year.	Masonry drains, lineal feet.	Sub-soil drains, lineal feet.	Open earth channels, lineal feet.
1908-1911 ... ..	17,420	50,400	—
1912 ... ..	2,550	97,900	—
1913 ... ..	8,970	109,200	25,300
1914 ... ..	5,780	70,000	—
1915 ... ..	5,410	15,600	—
1916-1917 ... ..	4,400	1,900	39,700
1918 ... ..	9,300	3,400	4,400
1919 ... ..	12,100	32,200	2,600
1920 ... ..	10,730	43,500	3,300
Totals ... ..	<u>76,660</u>	<u>424,100</u>	<u>75,300</u>

(iv) Owing to labour trouble in the early part of the year the maintenance was a bit behind hand, but matters steadily improved and during the latter half of the year the maintenance was good.

(v) The table below gives certain vital statistics with reference to death-rates and malaria in Kuala Lumpur:

Year.	Kuala Lumpur Town.			General Hospital, Kuala Lumpur : total malaria cases.		Indians at Police depôt, Kuala Lumpur.			Police hospital ward : total malaria cases admitted.
	Estimated population.	True total death-rate per 1,000.	True malaria death-rate per 1,000.	Treated.	Admitted.	Average population.	Malaria cases admitted in hospital.		
							Total.	Per cent. of population.	
1907	40,000	37.9	9.7						
1908	42,800	43.1	10.7						
1909	44,200	32.3	7.7						
1910	45,600	30.3	9.8	...	...	207	881	425	
1911	47,100	39.4	9.9	...	...	230	1,576	685	
1912	48,500	36.7	5.8	...	...	297	974	328	
1913	56,500	35.5	4.2	...	...	322	696	216	
1914	58,100	33.9	3.9	...	...	223	201	90	
1915	59,700	27.1	3.7	...	...	239	141	59	397
1916	61,400	27.7	3.5	...	...	231	257	111	543
1917	63,100	28.5	2.9	1,006	668	235	103	44	233
1918	64,700	38.4	4.0	977	602	186	99	53	244
1919	66,300	26.4	3.8	724	597	157	54	34	154
1920	67,900	30.0	4.2	1,016	844	134	44	33	195

NOTES.—(a) 1911. Census year.

(b) 1918. Influenza epidemic. Influenza persisted in 1919.

(c) The Indians at the Police depôt are Sikh and Pathan recruits for the Police Force.

(d) The Police ward at the General Hospital accomodates all sick police in the Kuala Lumpur district.



(vi) The area to be drained extends as the town enlarges and much has yet to be done in the improvement to river margins and the swamp lands adjacent.

#### PORT SWETTENHAM.

2. (i) Work on the drainage scheme, begun in 1917, was completed during the year. \$8,076.19 was expended during the year, and \$98,597.75 previously; a total of \$106,673.94 as against the estimate of \$105,000.

(ii) All drainage schemes require improvement from time to time to meet expansion of town area.

(iii) In consequence of the extension of the quarantine camp certain drainage work has been necessary and the expenditure on this work carried out by this office for the Government Architect amounted to \$8,473.79.

#### NEGRI SEMBILAN.

##### SEREMBAN.

3. (i) Steady progress has been made on the anti-malarial drainage of Seremban though hampered by the difficulty in obtaining labour at reasonable rates and the original drainage scheme is nearing completion.

The work done during 1920 includes 5,933 lineal feet of masonry drains

31,656 lineal feet of sub-soil drains

2,300 lineal feet of the Temiang River through the town has been canalized.

(ii) The town of Seremban is growing rapidly and the drained area will have to be extended accordingly.

##### PERAK.

4. The Acting Executive Engineer visited Taiping in connection with anti-malarial work there, but owing to staff shortage was unable to undertake any construction during the year.

##### PAHANG.

5. No work was done in Pahang during the year.

#### PRIVATE AUTHORITIES.

6. Owing to lack of staff little assistance has been afforded to private authorities for some years past.

#### GENERAL.

7. Co-operation has been maintained with the Senior Health Officer and the Medical Entomologist. The knowledge gained from the reports of the Medical Entomologist are being utilized in the drainage work.

(ii) The drainage work in Kuala Lumpur was inspected by various authorities and others interested both from this and other countries.

#### STAFF.

8. (i) Staff shortage continued to hamper work in every direction. The failure to obtain a number of senior assistants has been disappointing and discouraging.

With regards to the subordinate staff, efforts have been made to recruit subordinates from India and during the year two lower subordinates from the Madras College of Engineering, were engaged.

(iii) Mr. F. D. Evans continued as Executive Engineer until he proceeded on long leave on 3rd May.

Mr. P. A. Molloy, returning from long leave, reported for duty on 10th May, 1920, and acted as Executive Engineer in the absence of Mr. Evans. Lieut. F. M. Corkill continued as Assistant Engineer, Kuala Lumpur. Mr. J. E. Bach, Assistant Engineer in Seremban, resigned his appointment on 28th July, 1920, to join the Public Works Department.

The clerical staff consisted of one class II and two class III clerks.

The subordinate staff at the close of the year consisted of one grade II overseer, one assistant draftsman, two temporary subordinate engineering assistants.

P. A. MOLLOY,

*Acting Executive Engineer, Malaria Advisory Board, F.M.S.*



## REPORT OF THE INSTITUTE FOR MEDICAL RESEARCH, FOR THE YEAR 1920.

### I.—DYSENTERY.

During the year Dr. W. Fletcher, Bacteriologist, was engaged in a special investigation of dysentery. He reports as follows:

The Principal Medical Officer's records show that during the five years 1915 to 1919 more than 19,000 persons died from dysentery in the Federated Malay States; more, in fact, than died from any other disease with the exception of malaria. In some sections of the community the case mortality is very high, and in all dysentery is a frequent cause of debility and unfitness for work. In the year 1919, some 5,000 cases of dysentery were treated in Government hospitals and nearly a quarter of them died.

As implied above dysentery bears different aspects in different social surroundings and what is often no more than a trivial ailment, to the healthy European or the well-fed Asiatic, becomes a deadly disease when it attacks the sickly, half-starved cooly.

It is intended, therefore, in the year 1921 to study the disease in different classes of persons, and preliminary observations were carried out in 1920 principally among Europeans and also in the dysentery ward at the District Hospital in Kuala Lumpur, where most of the patients are coolies or beggars.

Including those examined in the course of routine clinical pathology, four hundred and eighty-two specimens of faeces were examined for dysentery bacilli. Organisms of the Flexner group were isolated from 116 samples, Shiga's bacillus from six and *Bacillus paratyphosus A.* from one.

The majority of the specimens were sent from hospitals in Kuala Lumpur; 295 from the District Hospital, 106 from the General Hospital and 24 from the European Hospital.

*The value of simple microscopical examination as a guide to treatment.*—Dysentery bacilli may disappear from the stool within one hour after passage and most observers agree that, even in temperate climates, they are not, as a rule, recoverable after six to eight hours.

In amœbic dysentery the necessity for early examination is equally imperative and the only safe course is to make the examination as soon as possible; occasionally, within two hours of the passage of the stool, most of the amœbæ will have disappeared.

In order to see what assistance in the diagnosis of dysentery can be given to medical officers who are stationed at a distance from the laboratory, cultures were made from a number of specimens which had been sent from Batu Gajah Hospital and which were, at least, twelve hours old before they were examined.

Dysentery bacilli were found in only one case out of 24. Some of the specimens were mixed with Teague and Clurman's glycerine and salt solution before being despatched; but even when this was done the results were no better.

It is not only useless to send dysentery stools for bacteriological examination from a hospital to a distant laboratory, but the results are likely to mislead the clinician who sends them. Fortunately, it is possible, in most cases, to distinguish between bacillary and amœbic dysentery by the examination of the faeces under the microscope and this can be done in any hospital.

The characteristic exudate of bacillary dysentery consists of plump pus cells and red blood-corpuscles. In acute amœbic dysentery on the contrary, pus cells are few in number or entirely absent, while, in addition to amœbæ, there are numerous red blood-corpuscles and bacteria.

In order to appraise the value of this method, an examination was made in 88 cases of dysentery from the District Hospital in Kuala Lumpur. In 69 of these cases, the preliminary diagnosis based on the microscopical examination of the stool, was subsequently confirmed by further investigation. In the remaining 19, which were nearly all old cases of long standing, the preliminary diagnosis was either wrong or doubtful. In early acute dysentery a correct diagnosis can be made in almost every case by simple microscopic examination, and this method promises to be most useful as a guide to treatment in hospitals and elsewhere, for it is obviously quite impracticable to examine every case bacteriologically.

### SPECIAL INVESTIGATION OF DYSENTERY AT THE DISTRICT HOSPITAL, KUALA LUMPUR.

*The preponderance of bacillary dysentery in the series of cases examined.*—In the opinion of many medical officers, dysentery of the amœbic type forms a very large proportion of all the cases which occur in Malaya, and in some hospitals any patient who passes blood and mucus in his stools is forthwith given a twelve day course of treatment with emetine. But it has been shown that emetine is not innocuous and unless it be true that dysentery in this country is almost always amœbic in type, or at least more often amœbic than bacillary, then this routine practice of giving emetine to every patient is a wrong one. It is, therefore, important to gauge the correctness of this view of the prevalence of amœbic dysentery and with this object, a special investigation was made (from October 13 to the end of the year) of 124 patients in the dysentery ward of the District Hospital.



Thirty-six of these patients were not suffering from dysentery; that is to say neither blood, mucus or pus was discovered in their excreta, by macroscopic or microscopic examination. Eight of them were passing hard, formed scybala. Six of these 36 cases died and were examined *post-mortem*, but in none of them were there any signs of dysentery. Two had died of pneumonia, two of malaria, one from tuberculosis and one from gangrene of the leg.

The faeces of the remaining 88 cases contained blood and mucus or pus, and the results of examination which were as follows, show that dysentery bacilli were found in 67 per cent. of the cases and amœbæ in 21 per cent.

<i>Entamœba histolytica</i>	...	...	...	...	...	...	17
" and <i>B. dysenteriae</i> .	...	...	...	...	...	...	2
<i>B. dysenteriae</i> .	...	...	...	...	...	...	55
" <i>Shiga</i>	...	...	...	...	...	...	2
No pathogenic organisms or protozoa found	...	...	...	...	...	...	12
Total	...	...	...	...	...	...	88

*Cases in which the cause of dysentery was not discovered.*—In two of the twelve cases, in which no cause was found for the blood and pus cells in the faeces, the exudate was of the bacillary type, and in each instance the patient had been ill for only two days, but though two examinations were made in one case and three in the other, dysentery bacilli were not isolated.

Two more of these patients were probably suffering from long standing bacillary infection and in each case the titre of the blood-serum was higher than one in four hundred, for Flexner's bacillus.

Six other cases were probably amœbic; the exudate was of the amœbic type and the serum content in agglutinins for dysentery bacilli was low.

In the two remaining cases, an intermittent discharge of blood and pus was possibly due to non-dysenteric ulceration of the rectum.

*Cases due to infection with organisms not hitherto recognized as causes of dysentery.*—In the group of cases examined there was no evidence of dysentery due to other causes than infection with *Entamœba histolytica* or with bacilli of the Flexner or Shiga types.

*Trichomonas* were present in almost every loose faecal stool which was examined.

*B. ambiguus* (Andrewes) was found in two cases, but there was evidence to show that it was not the cause of the patient's illness.

An organism was isolated on two occasions, from patients examined early in the disease, which was agglutinated to high titre both by the patient's own serum and by a stock Flexner anti-serum; but though it resembled Flexner's bacillus in every other respect, it lacked the primary character of fermenting mannite, even after repeated subculture and testing with different samples of that alcohol. In one of these two cases, the same organism was found after death in a small abscess situated in the mucous lining of the cæcum.

The two strains are presumably of the same race, for an immune serum prepared from one of them agglutinated the other to full titre.

*Agglutination tests as a guide to diagnosis.*—The blood-serum of 79 of the patients in the District Hospital series, was examined for the presence of agglutinins.

Fifty-three cases suffering from dysentery of the Flexner type agglutinated an emulsion of Flexner's bacillus as follows:

Agglutination titre less than 1 in 100	...	...	...	5 cases
" " between 1 in 100 and 1 in 200	...	...	...	14 "
" " higher than 1 in 200	...	...	...	34 "
			...	53 "

(A titre of 1 in 200 is regarded as positive evidence of Flexner infection.)

The serum of none of the patients gave a positive agglutination with an emulsion of Shiga's bacillus except that of two who were suffering from dysentery of the Shiga type, which, in each instance agglutinated an emulsion of the organism in a titre of 1 in 50.

(An agglutination titre of more than 1 in 10 is regarded as positive evidence of Shiga infection.)

The serum of 28 patients, in whose excreta no dysentery bacilli were found, was examined with the following results:

Agglutination of Flexner's bacillus at a titre lower than				
1 in 100	...	...	...	20 cases
Agglutination at titres between 1 in 100 and 1 in 200	...	...	...	2 "
" a higher titre than 1 in 200	...	...	...	6 "
			...	28 "



The agglutination test may be of value in determining the original cause of long standing dysentery, but it is of little service during the first few days of illness when the diagnosis is most important.

When the patient is very ill the development of agglutinins may be very slight; three of the five Flexner cases with an agglutinin titre of less than 1 in 100 terminated fatally.

*The value of a single bacteriological examination in determining the cause of dysentery.*—A very small sample of the stool is sent to the laboratory on each occasion and only a minute portion of the sample is examined. It sometimes happens that the sample is unsuitable in some way, or there may be some fault in the technique, so that though dysentery bacilli are present in the faeces they may escape detection at the first examination and it may be necessary to repeat the examination several times before finding the specific organism.

In the series of cases from the District Hospital, dysentery bacilli were found at the first examination on 44 occasions; not till the second examination in nine cases, and not until the third in four.

In the amoebic cases *E. histolytica* was found at the first examination 16 times, not until the third examination in one.

*Malaria as a cause of dysentery.*—The belief is current among medical men practising in the tropics that malaria *per se* is a cause of dysentery, quite apart from infection with dysentery bacilli or pathogenic amoebæ.

The examination of the 88 dysentery patients at the District Hospital showed no evidence in support of this belief, but there was cogent proof that malaria acted as a very important factor in their illness. Most of them had suffered from malaria before they were attacked by dysentery and in many cases the invasion of dysentery bacilli or amoebæ was a terminal infection.

Apart from the statements made by the patients, there was positive evidence of malaria in 40 per cent. of the cases; parasites were found in the blood of 30 of them, and five others had greatly enlarged spleens.

The high case mortality in this series of patients was undoubtedly very largely due to malaria.

*Duration of illness on admission.*—The "histories" obtained from patients of the cooly class are not very reliable; but from the accounts which they gave, 53 of them had suffered from dysentery for less than one week before admission; fifteen for more than one week but less than two; 20 for more than two weeks.

Sixteen of the 22 patients who died from bacillary dysentery, and all those who died from amoebic dysentery, had been ill for more than two weeks at the time of their death.

*The value of specific treatment.*—The majority of the patients in the District Hospital series were debilitated, malaria-stricken, starving, emaciated coolies. There was no evidence that the administration of anti-dysentery serum or emetine was of any benefit to these unfortunate people; rather, it appeared to do harm.

Anti-dysentery serum was administered to fourteen cases in doses of 50 to 175 c.cm. The duration of the dysentery in eight of these fourteen cases was not more than three days and in only three had the symptoms lasted more than a week; yet half of the patients, who were treated with serum, died.

Five of the seventeen amoebic cases died in spite of treatment with emetine.

*Fatal Cases.*—*Entamoeba histolytica* or dysentery bacilli were found in 76 of the District Hospital patients and 28 of these cases died.

55 Flexner dysentery patients	...	...	...	21 died
2 Shiga dysentery patients	...	...	...	1 "
17 Amoebic	...	...	...	5 "
2 Flexner and amoebic	...	...	...	1 "
Patients	76			
			Deaths	28 "

*Autopsies.*—*Post-mortem* examinations were made in 17 of the 28 fatal cases. Twelve of these examinations were carried out on persons from whom Flexner's bacillus had been isolated during life; but, in only six of these cases was there evidence of extensive and active enteritis to show that the patient had died from dysentery.

One of the Flexner cases was remarkable because the large intestine was quite healthy but there was an acute inflammation of the last eight feet of the small intestine, which was red and catarrhal in its upper part and covered with a fibrinous exudate for the last four feet. The inflammation ceased abruptly at the ileocaecal valve. *B. dysenteriae*, Flexner was isolated from the contents of the ileum.

In another case, examined *post-mortem*, the dysenteric inflammation had subsided and the ulcers were healed, but there were mamillated swellings in the thickened colon, most of them about the size of a split pea, but some of them larger; many of them had a depressed hæmorrhagic spot in the centre. Their contents were purulent, and a culture made from a large one in the cæcum contained 50 per cent. of dysentery bacilli of the Flexner type. Had this patient lived he might have become a chronic "carrier" of dysentery bacilli.



Of the remaining six cases of Flexner dysentery, there was no evidence, *post-mortem*, to show that dysentery was the cause of death; gangrenous cystitis was responsible for death in one case, malaria in three and starvation in two.

In the Shiga case which died, the dysentery was a terminal infection in the course of chronic tuberculosis. There were old cavities in the lungs and tubercular ulcers in the intestine from the pylorus down to the ileocaecal valve. In the ascending colon there were a few dysenteric ulcers and more in the descending part, while there were so many in the rectum that there was hardly any mucous membrane left. Tubercle bacilli were found in the ulcers of the small intestine and Shiga's bacillus was cultivated from those in the colon.

*Post-mortem* examinations were made in five fatal cases of amœbic dysentery; in two of them, the cause of death was pneumonia and in three amœbic ulceration. In one of the latter cases there was a single abscess in the right lobe of the liver.

*The reason for the high mortality.*—In most of the fatal cases the dysenteric infection was only a contributory cause of death. It is safe to say that in many instances dysentery alone would not have killed the patient; the real causes of death were malaria, tuberculosis and lack of food. Numbers of the patients were too feeble and emaciated when they were admitted to hospital for it to be possible that food or drugs should save them. It was their wretched condition from various causes, rather than the accident of dysentery, which was the cause of the high mortality. Some of the patients were little better than skeletons from lack of food or chronic disease and in such cases dysentery swoops down like a vulture upon its dying victim and hastens the fatal ending.

*Dysentery in Europeans.*—Specimens from fifty-three European patients were examined. *Entamœba histolytica* was found in three cases and *B. dysenteriae*, Flexner, was isolated in sixteen.

Dysentery, as it affects Europeans and well nourished Asiatics, is a trivial complaint compared with the same disease when it attacks debilitated coolies. It is a rare cause of death amongst adult persons who are otherwise healthy. It is, however, a common cause of invalidism, and in young children it is dangerous. Sometimes it is so severe and its onset is so sudden that the symptoms are ascribed to food-poisoning. The following case is an illustration of this. A little boy in Kuala Lumpur, three years old, was taken ill suddenly with vomiting and diarrhoea; his temperature rose to 105.5° and he had two convulsions. His mother thought that he was suffering from "food-poisoning" and no attempt was made to keep his brothers and sisters away from him. Four days later, his sister, 6 years old, was taken ill with diarrhoea, vomiting, fever and delirium. The next day, another sister, aged five, developed the same symptoms. Two days later two little brothers, twins a year old, became ill in the same way and one of them nearly died. Dysentery bacilli of the Flexner type were isolated from four out of the five cases.

In people who are otherwise strong and healthy, early serum treatment generally means a speedy cure.

## II.—PSEUDO-CHOLERA.

In previous annual reports reference has been made to the occurrence of groups of cases in which the onset of the disease resembled Asiatic cholera. The causative organism in certain of these cases has been identified and attention has been directed to the occurrence of natural infection in laboratory and domestic animals. Dr. Fletcher has shown that the causative organism is identical with that observed by him in 1914 as the cause of a very fatal epizootic among laboratory animals.

During the past year cultures of a micro-organism isolated by Major A. Whitmore, I.M.S. in the condition known as "Rangoon Disease," have been compared with the micro-organism of pseudo-cholera in Malaya and their identity has been established. In Rangoon, most cases of the disease have been identified only at *post-mortem* examination. In Malaya, there has been opportunity to study the earlier stages of the infection and also the immunity responses in cases ending in recovery.

During the period under review one case of the disease in the human subject was observed—a Tamil estate cooly, inmate of the General Hospital, Kuala Lumpur. In this case the course of the disease resembled more closely the Rangoon disease than the more severe forms of the infection hitherto encountered in Malaya. The causative organism, *Bacillus pseudomallei*, was isolated from small subcutaneous abscesses. Tests of the patient's blood serum against his own organism as well as against stock cultures from other sources showed agglutination in dilutions from 1 in 2,500 to 1 in 3,000. Additional proof is thus brought that the micro-organism is related causally to the infection and that the diseases observed in Burmah and Malaya are different forms of the same infection.

As has been noted in previous reports that epidemiological and experimental evidence points to the probability that the disease occurs as a natural infection in rodents and that it is communicated to man through food infection.

## III.—VENEREAL DISEASES.

The number of laboratory examinations in connection with these diseases has very greatly increased. This must not be taken as indicating any increase in these diseases generally but rather as evidence of a tendency to rely upon laboratory tests in diagnosis and in the control of treatment—a tendency, it should be added, not without its dangers.



One thousand eight hundred and twenty-six specimens of blood and cerebro-spinal fluid were tested by the Wassermann reaction, with seven hundred and seventy-seven positive results.

The numbers of specimens for the last four years are shown in the following table :

				Total.		Positive.
1917	...	...	...	143	...	87
1918	...	...	...	189	...	87
1919	...	...	...	453	...	170
1920	...	...	...	1,826	...	777

Ninety-five specimens were examined for the presence of *Treponema pallidum*, with positive results in 20 cases. A few specimens were examined for identification of the gonococcus.

Mr. Lesslar, Assistant Pathologist, compared the results of precipitation tests with the Wassermann reaction in 208 cases. The results showed that the Wassermann test was the more sensitive.

#### IV.—ENTERIC FEVERS.

Three hundred and forty-three specimens of blood were examined by the agglutination test with *Bacillus typhosus*; 85 gave positive results. Three hundred and five specimens with *B. paratyphosus A* gave 20 positive results. Three hundred and five with *B. paratyphosus B* gave 42 positive results.

*Bacillus typhosus* was identified in specimens of fæces on five occasions and in one specimen of urine. *B. paratyphosus A* was identified in one specimen of fæces. *B. paratyphosus B* was identified in one blood specimen and in one fæces specimen.

In several cases malaria parasites were observed in blood specimens sent for examination for enteric fever.

#### V.—CEREBRO-SPINAL FEVER.

Sporadic cases of cerebro-spinal fever have been identified in the Malay States at irregular intervals during the past ten years. There is some reason to believe that the disease is becoming more common and small outbreaks have occurred among Tamil estate labourers.

Forty-one specimens were received for examination for meningococci, 11 were positive. In 1919, 22 specimens were examined and 6 were positive. Sixty-eight tubes of polyvalent serum were issued for use in treatment and favourable results were reported.

#### VI.—OTHER INFECTIOUS DISEASES.

*Rabies*.—The brains of 17 animals were examined for Negri bodies, seven were positive.

*Diphtheria*.—Fifty specimens were examined with positive results in 11. Thirty-three tubes of diphtheria antitoxin were issued.

*Plague*.—There were few examinations and none gave a positive result.

*Cholera*.—Twenty-nine specimens were received for examination, one gave a positive result.

#### VII.—MISCELLANEOUS.

Tumour tissues examined numbered 44. Of these, 17 were malignant new growths.

Autogenous vaccines were prepared in 51 cases.

Fifty-one specimens of sputum were examined for the identification of specific micro-organisms or for culture. In 10 of these *B. tuberculosis* was present, in 17 *B. influenzae*.

Twenty-four specimens of urine were examined. Of 6 specimens submitted to bacteriological examination, *B. typhosus* was identified in one.

Four hundred and twenty-three specimens of blood fæces, sputum, etc., were examined microscopically.

Other specimens included mosquitos and their larvæ and water protozoa for identification.

#### VIII.—CHEMICAL SECTION.

Mr. R. W. Blair, Chemist, reports as follows :

The work in the chemical laboratory has been confined to routine examinations. The total number of examinations made during the year was 2,033. The numbers of exhibits under each heading are shown below :

Year.	Stains for blood.	Toxicological analyses.	Chandu.	Chandu Dross.	Deleterious drugs.	Waters.	Milks.	Liquors.	Toddy.	Coins, etc.	Miscellaneous.	Total.
1919	38	58	45		Nil	89	263	322	365	1,374	25	2,579
1920	64	106	143	58	19	114	315	690	365	110	49	2,033



1. *Stains*.—The number of stained articles examined for presence of blood was sixty-four. The articles consisted of knives, parangs and clothing.

The stains on twenty-seven articles gave the reactions characteristic of blood and of these nineteen gave the reaction characteristic of human blood (precipitin test).

2. *Toxicological*.—One hundred and six exhibits were examined for poisons. Forty of these were human viscera. Opium was found in three, morphine in one, and arsenic in three exhibits. Portions of viscera of cattle numbered ten, and in seven of these arsenic was found to be present.

3. *Chandu*.—One hundred and forty-three exhibits were examined. Nine contained illicit opium. Fifty-seven exhibits were dark brown viscous substances resembling chandu in appearance and were found to consist chiefly of glue, no chandu being present.

4. *Chandu Dross*.—Fifty-eight samples of chandu dross were examined. The majority of the samples were of good quality. In fifty-five of the samples the amount of morphine was estimated; forty-one were found to contain more than 4 per cent. of morphine—twenty-seven of these contained more than 5 per cent. of morphine.

5. *Water Samples*.—One hundred and fourteen samples of water from existing and proposed supplies were analysed. The Kuala Lumpur supplies were examined fortnightly, the Taiping supply four times, and the Seremban supply three times.

6. *Milk Samples*.—Three hundred and fifteen samples of fresh milk were examined.

The number from each district was as follows :

Kuala Lumpur ...	...	...	...	...	...	...	...	...	182
Klang ...	...	...	...	...	...	...	...	...	9
Ipoh ...	...	...	...	...	...	...	...	...	69
Taiping ...	...	...	...	...	...	...	...	...	46

The majority of the samples were taken under the provisions of the "Sale of Food and Drugs Enactment, 1913"; thirty-three per cent. of the samples were deficient in milk solids compared with thirty-one per cent. so deficient in 1919. Ninety certificates were issued for samples which failed to comply with the prescribed standards. Two samples of dried milk were received. No sample of condensed milk was received.

7. *Deleterious Drugs*.—Nineteen exhibits were examined for deleterious drugs. Eighteen were found to contain morphine.

8. *Liquors*.—Under this heading six hundred and ninety samples were examined. For admission to the approved list of spirits, twenty-five examinations were carried out. For percentage of alcohol only, six hundred and fifty-seven samples were examined as compared with two hundred and eighty-one in 1919. Nine samples of spirits were examined for denaturants, all of the samples were found to be effectually denatured.

9. *Toddy*.—Three hundred and sixty-five samples of toddy were examined. In ten samples the acidity (calculated as acetic acid) was over .8 per cent.—the highest being 1.54 per cent. The numbers from each State were as follows :

Selangor ...	...	...	...	...	...	...	...	...	258
Perak ...	...	...	...	...	...	...	...	...	83
Negri Sembilan ...	...	...	...	...	...	...	...	...	19
Pahang ...	...	...	...	...	...	...	...	...	5

The number of samples collected from toddy-shops under the control of managers of rubber estates was seventy-six.

10. *Coins and Coining Materials*.—Exhibits numbering one hundred and ten were examined. Counterfeit coins numbered one hundred and three, pieces of metal used in manufacture of counterfeit coins numbered five.

11. *Miscellaneous*.—The miscellaneous analyses numbered forty-nine and included one sample of urine, three of flour, two of Chinese medicines, one of paint, two of powders, one of camphorated chalk, three of fuel oil, one of sugar, one of bicarbonate of soda, four of aerated waters, one of quinine mixture and one sample of a deposit from a reservoir. Eleven Sikes' hydrometers were tested for accuracy.

#### STAFF.

Dr. W. Fletcher, Bacteriologist, was in charge of the laboratories from 1st January to 26th October.

Dr. A. T. Stanton was appointed Director, Government Laboratories, with effect from 1st July and resumed duty on 27th October.

Mr. H. Marsden, Assistant Chemist, returned from leave on 22nd December.

Two new appointments were made to posts of laboratory assistant.



## ANNUAL REPORT OF THE CENTRAL ASYLUM, FOR THE YEAR 1920.

Sir,—I have the honour to forward herewith the tenth annual report of the Federated Malay States Central Asylum, for the year 1920.

	Males.	Females.	Total.
There remained on 31st December, 1919	604	173	777
Admitted during 1920	310	96	406
Discharged	(a) recovered 132 (b) relieved 26 (c) not improved 2 (d) not insane 1	32 17 1 —	164 43 3 1
Absconded	21	—	21
Died	80	33	113
Remaining on 31st December, 1920	652	186	838
In addition there were Singapore patients—			
Remained on 31st December, 1919	129	39	168
Admitted during 1920	22	30	52
Discharged	5	2	7
Absconded	3	—	3
Died	14	3	17
Remaining on 31st December, 1920	129	64	193
Johore patients—			
Remained on 31st December, 1919	20	4	24
Admitted during 1920	19	3	22
Discharged	2	—	2
Died	4	1	5
Remaining on 31st December, 1920	33	6	39
Criminals—			
Remained on 31st December, 1919	48	3	51
Admitted during 1920	14	—	14
Discharged	6	1	7
Died	1	—	1
Absconded	3	—	3
Remaining on 31st December, 1920	52	2	54
Total remaining on 31st December, 1920	—	—	1,124
Percentage of Recoveries	40.39	per cent.	
Deaths	8.98	per cent.	

*Population.*—The total population has increased from 1,020 to 1,124.

The number of Federated Malay States patients increased from 777 to 838

„ Singapore patients increased from 168 to 193

„ Johore „ „ 24 to 39

„ Criminal „ „ 51 to 54

*Admissions.*—

The admissions of Federated Malay States patients decreased from 415 to 406

„ Singapore patients increased from 35 to 52

„ Johore „ „ 14 to 22

„ Criminal „ decreased „ 27 to 14

*Recoveries.*—One hundred and sixty-four Federated Malay States patients were discharged recovered giving a recovery rate of 40.39 per cent.

*Deaths.*—There were 136 deaths giving a death-rate of 8.98 per cent. The principal causes of deaths were:

Phthisis 26 deaths; malaria 25 deaths; dysentery 24 deaths; general paralysis of the insane 15 deaths. There were four deaths from pneumonia. There were no deaths from influenza.



*Fatalities.*—There were two fatalities (1) A Tamil patient fell down and struck his side against the edge of a latrine and died soon afterwards from a ruptured spleen. (2) A Chinese patient was savagely assaulted by a fellow Chinese patient while working in the pig farm and sustained a fractured skull, fractured ribs and a ruptured spleen. He died soon afterwards.

There were no suicides.

*Mental Diseases.*—The principal forms of mental disease on direct admissions and transfers were:

Recent melancholia	...	...	...	...	...	...	...	124
Recent mania	...	...	...	...	...	...	...	90
Confusional insanity	...	...	...	...	...	...	...	62
Primary dementia	...	...	...	...	...	...	...	34

There were 19 cases of general paralysis of the insane (15 males and 4 females).

*Farms.*—The approximate area under cultivation is 80 acres.

The total value of the produce was \$21,367.28, the principal items being:

Vegetables	...	...	...	...	...	...	...	\$13,430.33
Fruit	...	...	...	...	...	...	...	2,912.82
Pork	...	...	...	...	...	...	...	2,256.25
Fresh milk	...	...	...	...	...	...	...	1,142.50
Rice	...	...	...	...	...	...	...	343.39
Tobacco	...	...	...	...	...	...	...	333.75

A Fordson tractor was employed during part of the year. The tractor has proved capable of ploughing about one acre of lallang a day at an average cost of \$14 per acre.

*Anti-Malarial Work.*—A mosquito survey was carried out by the Health Department on 28th June, 1920. The following anopheles were found:

Maculatus, karwari, rossi, sinensis and feligenosus. A map showing the breeding places was prepared and these have been oiled daily. The number of cases of malarial fever which was large in the third quarter of the year has since diminished.

*New Buildings.*—I attach a table showing the buildings completed and nearing completion.

*Work.*—I attach a table showing the quantity and value of the work done.

*Maintenance.*—The cost of maintenance was \$291.73 per head, per annum, as compared with \$201.57 in 1919.

Dr. Samuels has been on leave, since 13th June, 1920.

Table A. I.—General table showing the movement of the asylum population during the year 1920:

	Certified patients.					
	M.	F.	Total.	M.	F.	Total.
On the asylum registers, 1st January, 1920	604	173	777			
Total cases admitted during the year	310	96	406			
„ under treatment during the year	—	—	—	914	269	1,183
Cases discharged, transferred during the year...						
Recovered	132	32	164			
Relieved	26	17	43			
Not improved	2	1	3			
Not insane	1	—	1			
Died during the year	80	33	113			
Absconded	21	—	21			
Total cases discharged, transferred and died during the year				262	83	345
On the asylum register, 31st December, 1920				652	186	838
Average daily number on registers during the year				—	—	1,074.86

Certified persons (*i.e.*—separate persons in contradistinction to “cases,” which may include the same individual more than once):

	M.	F.	Total.
Certified under care during the year	...	...	...
„ admitted	310	96	406
„ recovered	132	32	164



II.—Table showing the form of mental disorder on admission in the direct admissions and transfers during the year 1920:

Forms of mental disorder.		Direct admissions.			Transfers.			Total.							
		M.	F.	Total.	M.	F.	Total.	M.	F.	Total.					
Congenital or infantile mental deficiency (idiotcy or imbecility) occurring as early in life as it can be observed.	1.	Intellectual	(a) with epilepsy ...	—	1	1	...	—	—	—	...	—	1	1	
			(b) without epilepsy	2	3	5	...	—	—	—	...	2	3	5	
	2.	Moral	... ..												
Insanity occurring later in life.	1.	Insanity with epilepsy	...	6	3	9	...	—	—	—	...	6	3	9	
	2.	General paralysis of the insane	... ..	15	4	19	...	—	—	—	...	15	4	19	
	3.	Insanity with grosser brain lesions	... ..	4	2	6	...	—	—	—	...	4	2	6	
	4.	Acute delirium	...	1	—	1	...	—	—	—	...	1	—	1	
	5.	Confusional insanity	...	52	10	62	...	—	—	—	...	52	10	62	
	6.	Stupor	...	6	1	7	...	—	—	—	...	6	1	7	
	7.	Primary dementia	...	27	7	34	...	—	—	—	...	27	7	34	
	8.	Mania	(a) recent	...	70	20	90	...	—	—	—	...	70	20	90
			(b) chronic	...											
			(c) recurrent	11	1	12	...	—	—	—	...	11	1	12	
	9.	Melancholia	(a) recent	...	87	37	124	...	—	—	—	...	87	37	124
			(b) chronic	—	2	2	...	—	—	—	...	—	2	2	
			(c) recurrent	2	1	3	...	—	—	—	...	2	1	3	
	10.	Alternating insanity	...	2	3	5	...	—	—	—	...	2	3	5	
	11.	Delusional Insanity	(a) systematized	...	4	—	4	...	—	—	—	...	4	—	4
(b) non-systematized			16	—	16	...	—	—	—	...	16	—	16		
12.	Volitional insanity	(a) impulse													
		(b) obsession													
		(c) doubt	...												
13.	Moral insanity	...													
14.	Dementia	(a) senile	...	4	1	5	...	—	—	—	...	4	1	5	
		(b) secondary	1	—	1	...	—	—	—	...	1	—	1		
15.	Not insane	...													
Total				...	310	96	406	...	—	—	—	...	310	96	406

III.—Table showing the form of mental disorder on admission in those discharged, recovered during the year 1920:

Forms of mental disorder (on admission).				M.	F.	Total.
1. Intellectual	...	(a) with epilepsy	...	...	...	...
(b) without epilepsy	...	...	...	...	...	...
2. Moral	...	...	...	...	...	...
3. Insanity with epilepsy	...	...	...	1	1	2
4. Acute delirium	...	...	...	...	...	...
5. Confusional insanity	...	...	...	22	5	27
6. Stupor	...	...	...	4	—	4
7. Primary dementia	...	...	...	12	3	15
8. Mania	...	(a) recent	...	20	6	26
(b) chronic	...	...	...	...	...	...
(c) recurrent	...	...	...	5	—	5
9. Melancholia	...	(a) recent	...	53	13	66
(b) chronic	...	...	...	1	—	1
(c) recurrent	...	...	...	1	—	1
10. Alternating insanity	...	...	...	5	2	7
11. Delusional insanity	...	(a) systematized	...	1	—	1
(b) non-systematized	...	...	...	5	—	5
12. Volitional insanity	...	(a) impulse	...	—	1	1
(b) obsession	...	...	...	...	...	...
(c) doubt	...	...	...	...	...	...
13. Moral insanity	...	...	...	—	1	1
14. Dementia	...	(a) senile	...	...	...	...
(b) secondary	...	...	...	2	—	2
Total				132	32	164



## IV.—Analysis of the discharges and transfers during the year 1920:

	M. F. Total.	M. F. Total.	M. F. Total.
Discharged as recovered from direct admissions—			
First-attack cases ... ..	29 9 38		
Not first-attack cases ... ..	20 1 21		
Cases unknown whether first attack or not ... ..	83 22 105		
Total from direct admissions ...	132 32 164		
From transfers—			
First-attack cases ... ..			
Not first-attack cases ... ..			
Cases unknown whether first attack or not			
Total from transfers ... ..			
Total discharged as recovered ... ..		Relieved.	Not improved.
Discharged (not recovered) as—			
Relieved ... ..	26 17 43	26 17 43	
Not improved ... ..	2 1 3	— — —	2 1 3
Total ...	28 18 46		
Reasons for such discharges—			
To go to care of friends ... ..	28 18 46		
Statutory, by irregularity in reception order ... ..			
Other reasons (specifying them) ...			
Total ...	28 18 46		
Transferred as—			
Relieved ... ..			
Not improved ... ..			
Total ...			
Destinations of such transfers—			
To Leper Asylum ... ..			
To single care ... ..			
Other destinations (specifying such) ...			
Total ...			
Total discharged and transferred as—			
Relieved ... ..	—	26 17 43	
Not improved ... ..	—	—	2 1 3

V.—Table showing the form of mental disorder on 31st December, 1920, of those on the registers at that date:

	Forms of mental disorder on 31st December, 1920.	M.	F.	Total.
Congenital or infantile mental deficiency (idiotcy or imbecility) occurring as early in life as it can be observed.	1. Intellectual ... { (a) with epilepsy ... ..	—	1	1
	{ (b) without epilepsy ... ..	10	10	20
Insanity occurring later in life.	2. Moral ... ..			
	1. Insanity with epilepsy ... ..	12	4	16
	2. General paralysis of the insane ... ..	6	2	8
	3. Insanity with grosser brain lesions ... ..	6	4	10
	4. Acute delirium ... ..			
	5. Confusional insanity ... ..	53	15	68
	6. Stupor ... ..	36	5	41
	7. Primary dementia ... ..	50	8	58
	8. Mania ... { (a) recent ... ..	42	10	52
	{ (b) chronic ... ..	15	3	18
	{ (c) recurrent ... ..	8	3	11
	9. Melancholia ... { (a) recent ... ..	60	25	85
	{ (b) chronic ... ..	24	11	35
	{ (c) recurrent ... ..	3	—	3
	10. Alternating insanity ... ..	10	3	13
	11. Delusional insanity { (a) systematized ... ..	12	2	14
	{ (b) non-systematized ... ..	29	—	29
	12. Volitional insanity { (a) impulse ... ..	2	—	2
	{ (b) obsession ... ..			
	{ (c) doubt ... ..			
	13. Moral insanity ... ..			
	14. Dementia ... { (a) senile ... ..	9	3	12
	{ (b) secondary ... ..	265	77	342
	15. Not insane ... ..			
Total ...		652	186	838
Prospect of mental recovery ... { favourable.				
{ doubtful.				
{ unfavourable.				



## (VI)—Specific diseases which caused death during 1920 :

Phthisis ... ..	26
Malaria ... ..	25
Dysentery ... ..	24
General paralysis of the insane ... ..	15
Ankylostomiasis ... ..	6
Debility ... ..	5
Pneumonia ... ..	4
Tertiary syphills ... ..	4
Exhaustion ... ..	4
Septic absorption ... ..	2
Peritonitis ... ..	2
Valvular disease of heart ... ..	2
Epilepsy ... ..	2
Ruptured spleen ... ..	2
Chronic empyema ... ..	1
Cerebral hæmorrhage ... ..	1
Cancer of liver ... ..	1
Intestinal obstruction ... ..	1
Peri splenitis ... ..	1
Scalp wound ... ..	1
Sub-phrenic abscess ... ..	1
Chronic endocarditis ... ..	1
Cancer cervix uterus ... ..	1
Cellulitis ... ..	1
Uræmic coma ... ..	1
Meningitis ... ..	1
Chronic bright's disease ... ..	1
Total ... ..	136

W. M. CHAMBERS,

*Acting Medical Superintendent, Central Asylum, Tanjong Rambutan.*



# REPORT OF SENIOR HEALTH OFFICER, FEDERATED MALAY STATES, FOR THE YEAR 1920.

## STAFF.

*Appointments.*—January 2nd, Dr. Bruce Low transferred from Medical Branch. February 2nd, Dr. Savage, local appointment. August 12th, Dr. Thomson, local and temporary appointment. December 9th, Dr. Cosgrave transferred from Medical Branch. December 22nd, Dr. Moir, from England. Appointed by Secretary of State.

*Transfers.*—May 8th, Dr. Bruce Low relinquished his post to accept one under the Ministry of Health.

*Retirements.*—March 13th, Dr. Meldrum, medically unfit. August 28th, Dr. Clarke.

*Deaths.*—November 19th, Dr. Delmege.

*Distribution of Staff.*—Senior Health Officer, January 1st to December 31st, Dr. Wellington. Health Officer, Perak North, January 1st to June 4th, Dr. Clarke. June 4th to December 31st, Dr. Black. Health Officer, Kinta, January 1st to December 31st, Dr. Green. Health Officer, Lower Perak and Batang Padang, January 1st to June 4th, Dr. Black. June 4th to August 12th, Dr. Green. August 12th to December 31st, Dr. Thomson. Health Officer, Selangor, January 2nd to May 9th, Dr. Bruce Low. May 8th to August 3rd, Dr. Wellington. August 3rd to December 31st, Dr. Savage. Health Officer, Coast, January 1st to February 16th, post vacant. February 16th to October 23rd, Dr. Savage. October 23rd to December 22nd, Drs. Cosgrave and McDonald. December 22nd to December 31st, Dr. Moir. Health Officer, Negri Sembilan, January 1st to November 17th, Dr. Delmege. November 17th to December 12th, Dr. Milne. December 12th to December 31st, Dr. Cosgrave. Health Officer, Pahang, post not filled.

## SCHEME FOR ENLARGEMENT OF THE HEALTH DEPARTMENT.

In May, 1919, a scheme was submitted to Government increasing the staff to 15 health officers and 8 chief sanitary inspectors. The scheme was sanctioned by the Secretary of State and the necessary items were entered in the 1920 Estimates.

For the greater part of the year there were six health officers, for the remainder only five. In the majority of cases the officer was new to his district and new to his work. There were no chief sanitary inspectors.

## HOUSE AND OFFICE ACCOMMODATION.

The duties of the Health Department include:

### A. Work under—

- (1) Quarantine and Prevention of Diseases Enactment;
- (2) Sanitary Boards Enactment;
- (3) Labour Code;
- (4) Sale of Food and Drugs Enactment;
- (5) Excise Enactment.

B. Malaria investigation, anti-malarial measures and anti-mosquito measures.

C. General, water and water-borne diseases, flies—prevalent diseases.

A (1). *Work under the Quarantine and Prevention of Diseases Enactment.*—Responsibility under this enactment is shared with the medical branch.

One case of plague was reported from Selangor.

In Perak, there was a small-pox epidemic which was chiefly confined to Malays. It caused 155 deaths.

There were six deaths from cholera in Selangor and one in Pahang.

Cerebro-spinal meningitis is making its appearance. There were 12 deaths in Selangor, 10 in Perak and 1 in Pahang.

A (2). *Work under the Sanitary Boards Enactment.*—Work under the Sanitary Board includes supervision of housing and building operations, licensing of premises, inspection of licensed premises, inspection of water supplies, inspection of drainage, malaria and anti-malarial measures, anti-mosquito measures, vital statistics.

Up till now no town has had a full time Health Officer. Next year it is proposed to give each of the four large towns a full time Health Officer.

A (3). *Labour Code, work under.*—Under this code the Principal Medical Officer is the medical officer with power to delegate his authority to others, and he has delegated it to the Health Branch.

The chief work of the department lies in the inspection visits made to estates for the purpose of attempting to get a reasonable standard of sanitation on them.



Health officers paid 384 visits to estates and sanitary inspectors 674. With regard to hospitals, 135 visits were paid by health officers and 350 by sanitary inspectors 275 visits of inspection were paid to Public Works Department. Throughout the year the policy of working in close touch with the Labour Department was kept up and there was a mutual exchange of reports.

A (4). *Work under the Sale of Food and Drugs Enactment.*—Work under the Sale of Food and Drugs Enactment forms an important part of the duties of a health officer at home, and the same should apply here. When the staff is more complete action will be taken.

A (5). *Work under the Excise Enactment.*—Work under this enactment consists in keeping a watch on the toddy trade and on the spirit trade. All toddy-shops are visited periodically by the health inspectors and samples taken for analysis. Where samples convene the standards laid down by law the vendors are prosecuted.

B. *Malaria, malaria investigation and anti-malarial measures.*—The four bodies dealing with malaria and anti-malarial measures are: The Malaria Advisory Board, the Malaria Bureau, the various Sanitary Boards and the Health Department.

As usual malaria heads the list as the most prominent cause of death. It accounted for 20,595 deaths, that is 47.12 per cent. of the total deaths. The rate was 15.24 per mille. This figure, which about equals the total rate for all diseases in the United Kingdom, is far too high. Nor are deaths the only losses from malaria; for every one who dies probably twenty-five or more are invalided temporarily or permanently. Considering that this is a preventable disease the high invaliding and death-rates are most deplorable. It is no exaggeration to say that the country loses millions of people a year through malaria.

The teaching of mosquitology continued throughout the year. Most of the health inspectors are now able to identify anophelines and a few might almost be called experts.

Charts for the quick identification of anophelines both in the larval and adult stages were prepared by the writer. Lithographed copies were sent to medical practitioners and hospitals in the Federated Malay States, the Straits Settlements and in Kedah. These charts were intended to provide the malaria student with a simple and easy method of identifying the Malayan anopheles. From the letters of appreciation received it is clear a definite want has been satisfied.

Experiments were made to find out the most economical method of killing larvæ by oils. Dr. Hacker's experiments had demonstrated that the low flash oils have the greatest killing powers. The result of the experiments showed equal parts of kerosene and liquid fuel to be the best mixture.

Mosquito surveys were made at Taiping, Tapah, Bidor, Batu Gajah, Sungkai, Tanjong Rambutan, Kuala Kubu, Kuala Lumpur, Batu Tiga, Post Swettenham, Morib, the Gap, Bukit Fraser, Raub and Gemas. Reports with recommendations were made in each case.

Bidor station was investigated at the request of the railway authorities. A report with recommendations was sent in. Oiling was recommended and an inspector from Tapah visited weekly to superintend.

A mosquito survey was made at Tanjong Rambutan at the request of the Leper Settlement Committee.

Kuala Kubu was investigated because of the amount of malaria among the railway staff.

Dr. Malcolm Watson having declared the Sanatorium, Morib, to be malarious an investigation was made to ascertain the cause. *A. Ludlowi* was discovered to be breeding in the vicinity. Action is being taken.

Conditions at the Gap have changed owing to the opening up of valleys and the disturbance of earth consequent upon the construction of a road to Bukit Fraser. Anophelines are now breeding in the opened valleys and malaria is prevalent.

A request was received from the Acting British Resident, Pahang, to make search for anophelines at Bukit Fraser. *A. Karwari* and *A. Leucosphyrus* was found breeding there and it was prophesied that *Maculatus* would appear as the valleys were opened up. A later visit showed a number of *Maculatus* breeding grounds. An inspector was sent to the district to advise as to what should be done.

Raub, because of the amount of malaria there, was investigated. An anopheline survey showed *A. Maculatus* breeding in the cleared valleys and in the seepage at the hill slopes bordering on the padang.

Gemas was investigated at the instance of the General Manager, Railways. A report with recommendations was sent in. The recommendations included proposals for Public Works Department work and for railway work. The railway are taking action.

*Anti-Mosquito Boards.*—The British Resident of Perak, Mr. George Maxwell, evolved a scheme for local anti-mosquito boards under the chairmanship of the Health Officer. The first board was formed in Taiping about the middle of the year. The scheme proved a success and similar boards were formed in other districts of the State. In the coming year the system will be extended to the other States in the Federation.



*Notification of Malaria.*—Malaria was made a notifiable disease in Taiping. It was regarded as an experiment which might or might not prove successful. The results were so good that it has been decided to adopt the same system in Kuala Lumpur.

C (i) *Water and Water Borne Diseases.*—Dysentery and diarrhoea rank next to malaria as a cause of death. The number of deaths were 3,804, and the death-rate was 2.81. Contaminated water is one of the principal causes of diarrhoea and dysentery.

(ii) *Carriers of Disease.*—Flies are far too prevalent in our towns and villages. The chief breeding places are the town refuse dumps. All refuse should be properly buried or burned. To burn thoroughly incinerators properly constructed and properly run are essential.

Years ago a similar attempt was made at Rawang and proved a failure.

The proper way to protect from flies is to attack the source. With good scavenging and good disposal flies will be conspicuous by their absence.

(iii) *Pulmonary tuberculosis.*—This ranks third as a cause of death. The Health Officer, Kuala Lumpur, states "though many new dwelling houses have been erected there are parts of the town where overcrowding exists to an appalling degree. Until this overcrowding is rectified there is not much likelihood of there being a marked reduction of the tuberculosis death-rate."

(iv) *Ankylostomiasis.*—I am not convinced that ankylostomiasis is the scourge some would make it out to be. I do not deny that a pernicious anæmia due to ankylostomes exists but I consider it comparatively rare in the Federated Malay States. Malaria is the great disease of these lands and causes most of the anæmia of the cases described as ankylostomiasis.

(v) *Pneumonia.*—Pneumonia is debited with 2,909 deaths giving a death-rate of 2.15 per mille. Probably much of the pneumonia was influenzal.

(vi) *Influenza.*—Influenza was present during the year and had an influence on the mortality figures but there was no definite epidemic.

*Infantile Mortality.*—There were 6,910 deaths of children under one year of age giving an infantile mortality rate of 189.03 per 1,000 births. The average rate for the last ten years was 195.62. The high mortality figure is no doubt chiefly the result of carelessness and ignorance on the part of the women.

Convulsions, the cause assigned to 3,460 deaths, is not a disease but a symptom. Most of the deaths were probably due to gastro-intestinal troubles, the result of bad feeding or to malaria.

#### VITAL STATISTICS (FEDERAL).

##### POPULATION.

The estimated population for the year was 1,351,541. Assuming that the ratio was the same as in 1911, the race distribution was as follows:

Europeans and Americans	...	...	...	...	...	4,880
Eurasians	...	...	...	...	...	3,635
Malays and other races of the Archipelago	...	...	...	...	...	515,347
Chinese	...	...	...	...	...	548,935
Indians	...	...	...	...	...	272,505
Others	...	...	...	...	...	6,239
						<hr/> 1,351,541 <hr/>

In the foreign population which forms 62 per cent. of the total the males outnumber the females by 4 to 1.

Immigration and emigration have more influence on the population than have births and deaths and the population is steadily increasing despite the fact that the death-rate is higher than the birth-rate.

##### BIRTHS.

Thirty-six thousand five hundred and fifty-six births were registered during the year giving a birth-rate of 27.05 per mille population. In 1919, the number was 32,325 and the rate 24.57.

Race.	No. of births.	Birth-rate.
Europeans and Americans	...	...
Eurasians	...	...
Malays and other races of the Archipelago	...	...
Chinese	...	...
Indians	...	...
Others	...	...
Europeans and Americans	145	29.71
Eurasians	102	28.06
Malays and other races of the Archipelago	18,968	36.81
Chinese	8,279	15.06
Indians	8,940	32.81
Others	122	19.51



## DEATHS.

Forty-three thousand seven hundred and five deaths were registered giving a death-rate of 32.34 per mille. The rate for 1919 was 29.37.

The distribution of deaths among the several races was as follows :

Race.	No. of deaths.	Death-rate.
Europeans and Americans ... ..	35	7.17
Eurasians ... ..	49	13.48
Malays and other races of the Archipelago ...	14,685	28.49
Chinese ... ..	15,565	28.35
Indians ... ..	13,192	48.41
Others ... ..	179	28.69

The deaths and death-rates for the total population for the last ten years were as follows :

Year.	Population.	Deaths.	Rate per mille.
1911 ... ..	1,045,947	40,914	39.11
1912 ... ..	1,081,799	40,901	37.80
1913 ... ..	1,117,625	38,000	34.00
1914 ... ..	1,136,500	39,000	34.31
1915 ... ..	1,172,336	33,899	28.92
1916 ... ..	1,208,177	36,985	30.60
1917 ... ..	1,244,018	42,514	34.17
*1918 ... ..	1,279,859	67,639	52.85
1919 ... ..	1,315,700	38,645	29.37
1920 ... ..	1,351,541	43,705	32.34

Table showing causes of deaths in 1920 :

Disease.	No. of deaths.	Rate per mille.
Malaria ... ..	20,595	15.24
Dysentery and diarrhoea ... ..	3,804	2.81
Pneumonia ... ..	2,909	2.15
Pulmonary tuberculosis ... ..	2,634	1.95
Ankylostomiasis ... ..	601	.44
Beri-beri ... ..	431	.32
Bright's disease ... ..	151	.11
Syphilis ... ..	130	.09
Enteric ... ..	33	.02
Tetanus ... ..	20	.01
Malignant disease ... ..	11	.008
Influenza ... ..	542	.4
Diphtheria ... ..	3	.002
Convulsions ... ..	3,460	2.56
Other diseases ... ..	12,820	9.48

The diseases which caused the greatest number of deaths were malaria, dysentery and diarrhoea, pneumonia and pulmonary tuberculosis.

The following table shows the deaths and the death-rates from the principal diseases for the last ten years :

Year.	Malaria.		Dysentery and diarrhoea.		Pulmonary tuberculosis.		Beri-beri	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.
1911 ... ..	18,280	17.47	7,659	7.31	2,300	2.20		
1912 ... ..	17,870	16.52	5,885	5.44	1,353	1.25	1,212	1.12
1913 ... ..	16,414	14.69	5,317	4.75	1,623	1.45	1,190	1.06
1914 ... ..	13,634	11.99	5,235	4.60	1,655	1.45	1,223	1.07
1915 ... ..	15,208	12.97	3,148	2.68	1,995	1.70	871	.74
1916 ... ..	17,627	14.58	3,197	2.64	2,193	1.81	757	.62
1917 ... ..	18,750	15.07	4,942	3.97	2,446	1.96	1,207	.97
1918† ... ..	31,515	24.62	4,280	3.34	3,184	2.48	1,277	.98
1919 ... ..	16,975	12.90	3,712	2.82	2,445	1.86	939	.71
1920 ... ..	20,595	15.24	3,804	2.81	2,634	1.95	431	.32

In comparing death figures for particular diseases the fact should not be forgotten that the vast majority of cases were not attended during life by anyone skilled in medicine and the diagnosis were made after death by native police who have practically no knowledge of disease. Such a system necessarily engenders an enormous probable error and reduces the value of statistics accordingly.

\* High figure due to influenza epidemic.

† Influenza epidemic year.



VITAL STATISTICS (*State figures for comparison*).  
Estimated population of all races on June 30th, 1920.

State.	Europeans and Americans.	Eurasians.	Malays and other natives of the Archipelago.	Chinese.	Indians.	Others.	Total.
Perak ... ..	2,031	1,066	249,120	276,189	107,694	2,742	638,842
Selangor ... ..	2,082	1,848	86,223	187,053	124,134	2,288	403,628
Negri Sembilan ...	630	602	80,954	47,764	29,387	768	160,096
Pahang ... ..	137	119	99,050	37,929	11,299	441	148,975
Total, F.M.S. ...	4,880	3,635	515,347	548,935	272,505	6,239	1,351,541

VITAL STATISTICS (*State figures for comparison*).

Birth Table.

State.	No. of births.	Birth-rate per 1,000 living.	1919 birth-rate.
Perak ... ..	17,000	26.61	24.59
Selangor ... ..	10,865	26.91	22.72
Negri Sembilan ...	4,809	30.03	26.74
Pahang ... ..	3,882	26.06	27.05

Birth Statistics of different nationalities.

STATE.	Europeans and Americans.		Eurasians.		Malays and other races of the Archipelago.		Chinese.		Indians.		Other races.	
	No. of births.	Birth-rate.	No. of births.	Birth-rate.	No. of births.	Birth-rate.	No. of births.	Birth-rate.	No. of births.	Birth-rate.	No. of births.	Birth-rate.
Perak ... ..	57	28.05	29	27.18	9,042	36.30	4,049	14.66	3,783	35.13	40	14.59
Selangor ... ..	76	36.5	58	31.38	3,604	41.80	2,653	14.18	4,445	35.81	29	12.68
Negri Sembilan ...	7	11.11	13	21.59	3,095	38.23	1,095	22.92	557	18.96	42	54.68
Pahang ... ..	5	36.49	2	16.8	3,227	32.57	482	12.7	155	13.71	11	24.94

VITAL STATISTICS (*State figures for comparison*).

Deaths Table.

State.	No. of deaths.	Death-rate.	Death-rate, 1919.
Perak ... ..	19,188	30.03	27.55
Selangor ... ..	13,529	33.51	29.40
Negri Sembilan ...	6,792	42.42	39.43
Pahang ... ..	4,196	28.16	26.22
Total, F.M.S. ...	43,705	32.34	29.37

Deaths and Rates of different nationalities.

State.	Europeans and Americans.		Eurasians.		Malays and other natives of the Archipelago.		Chinese.		Indians.		Others.	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.
Perak ... ..	10	4.92	14	13.13	6,917	27.75	7,148	25.88	5,059	46.98	40	14.59
Selangor ... ..	17	8.16	28	15.15	2,571	29.82	4,947	26.45	5,920	47.69	46	20.10
Negri Sembilan ...	5	7.93	6	9.96	2,440	30.14	2,468	51.66	1,799	61.22	74	96.35
Pahang ... ..	3	21.89	1	8.40	2,757	27.83	1,002	26.41	414	36.64	19	43.08



Table showing deaths and death-rates from principal diseases.

State.	Malaria.			Dysentery and diarrhoea.			Pulmonary tuberculosis.			Beri-beri.		
	Deaths.	Rate.		Deaths.	Rate.		Deaths.	Rate.		Deaths.	Rate.	
		1920	1919		1920	1919		1920	1919		1920	1919
Perak ... ..	10,112	15.82	13.45	1,413	2.21	2.21	1,350	2.11	1.83	80	.12	.25
Selangor ... ..	5,300	13.13	10.23	1,522	3.77	3.59	763	1.89	2.39	137	.33	.82
Negri Sembilan ... ..	2,912	18.18	17.15	691	4.31	4.77	380	2.37	1.39	152	.94	2.00
Pahang ... ..	2,271	15.24	13.22	178	1.19	1.27	141	.94	1.01	62	.41	.99

Infantile Mortality Table.

State.	Deaths of children under one year of age.	Death-rate per 1,000 births.
Perak ... ..	3,064	180.13
Selangor ... ..	2,112	194.38
Negri Sembilan ... ..	945	196.50
Pahang ... ..	789	203.24

Deaths from Zymotic diseases.

State.	Plague.	Cholera.	Small-pox.	Cerebro-spinal meningitis.
Perak ... ..	—	—	155	10
Selangor ... ..	1	6	—	12
Negri Sembilan ... ..	—	—	—	—
Pahang ... ..	—	1	—	1

State figures for comparison.

Year.	Perak.			Selangor.			Negri Sembilan.			Pahang.		
	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.
1915 ... ..	14.12	2.43	2.12	11.75	3.48	1.48	13.68	2.92	1.12	10.28	1.41	1.07
1916 ... ..	15.26	1.91	2.40	13.57	4.03	1.44	16.53	3.58	1.00	12.26	1.12	1.03
1917 ... ..	15.81	2.58	2.25	12.75	4.38	1.47	18.81	4.26	2.80	14.00	1.30	1.14
1918* ... ..	Unreliable			20.29	3.78	1.62	36.31	5.84	4.93	26.62	1.63	1.41
1919 ... ..	13.45	2.21	1.83	10.23	3.59	2.39	17.15	4.77	1.39	13.22	1.27	1.01
1920 ... ..	15.82	2.21	2.11	13.13	3.77	1.89	18.18	4.31	2.37	15.24	1.19	.94

Vital statistics of the four large towns, Kuala Lumpur, Ipoh, Seremban and Taiping. The population in each case is that within the Sanitary Board limits.

The crude death-rates are calculated on the total number of deaths within Sanitary Board limits.

The corrected death-rates are calculated on the total number of deaths occurring within the Sanitary Board limits and including infants less than 30 days old but excluding deaths of other persons who had been, at the date of death, resident for less than 30 days within Sanitary Board limits.

Town.	Estimated population.	Births.		Deaths of persons who previous decease had resided in town one month.	
		No.	Rate per mille.	No.	Rate per mille.
Kuala Lumpur ... ..	67,930	1,496	22.02	2,038	30.
Ipoh ... ..	34,357	866	25.21	778	22.64
Seremban ... ..	15,006	476	31.72	511	34.05
Taiping ... ..	25,434	748	29.40	1,015	39.90

\* Influenza year figures probably very inaccurate.



Table showing corrected deaths and death-rates during last six years :

Year.	Kuala Lumpur.		Taiping.		Ipoh.		Seremban.	
	Population.	Death-rate.	Population.	Death-rate.	Population.	Death-rate.	Population.	Death-rate.
1915 ...	59,727	27.83	21,615	33.99	28,796	27.8	11,007	47.15
1916 ...	61,443	27.73	22,237	36.	29,915	30.15	11,397	52.55
1917 ...	63,064	28.45	22,859	31.	31,032	32.67	13,620	55.35
1918 ...	64,686	38.34	23,481	41.61	32,150	35.92	14,082	81.66
1919 ...	66,308	26.36	24,721	37.45	33,238	23.56	14,544	45.38
1920 ...	67,930	30.	25,434	39.90	34,357	22.64	15,006	34.05

Table showing corrected deaths and death-rates for principal diseases:

Town.	Malaria.		Dysentery and diarrhoea.		Pulmonary tuberculosis.		Beri-beri.	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.
Kuala Lumpur ...	345	5.08	169	2.49	237	3.49	23	.34
Ipoh ...	194	5.64	91	2.64	129	3.75	6	.17
Seremban ...	135	8.99	75	5.	51	3.40	22	1.47
Taiping ...	487	19.14	76	2.99	40	1.57	6	.24

Infantile Mortality Table.

Town.	Births.	Deaths under one year.	Rate per 1,000 births.
Kuala Lumpur ...	1,496	368	245.99
Ipoh ...	866	137	158.19
Seremban ...	476	142	298.32
Taiping ...	748	151	209.89

Table showing corrected death-rates in the four towns for the past five years :

Year.	Kuala Lumpur.			Ipoh.			Seremban.			Taiping.		
	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.	Malaria.	Dysentery and diarrhoea.	Pulmonary tuberculosis.
1916 ...	6.64	2.77	3.06	15.34	2.77	2.77	23.51	7.02	1.75	14.13	5.12	3.85
1917 ...	4.65	3.47	3.23	11.98	2.70	3.67	22.33	8.	1.47	11.16	3.79	3.62
1918 ...	6.08	4.05	3.43	7.52	3.85	4.72	40.83	10.01	3.48	22.32	2.65	2.03
1919 ...	4.69	3.35	3.24	6.32	3.55	3.09	19.18	7.70	3.71	16.78	3.52	2.42
1920 ...	5.08	2.49	3.49	5.64	2.64	3.75	8.99	5.	3.40	19.14	2.99	1.57

## ESTATE STATISTICS.

Returns were received from 1,156 estates. Besides these, there are many small estates of less than 100 acres each which do not send returns. The 1,156 estates are distributed as follows:

Perak ...	Perak North...	...	230	546
	Kinta ...	...	119	
	Lower Perak and Batang Padang...	...	197	
Selangor ...	Bernam ...	...	8	349
	Coast Districts ...	...	163	
	Kuala Lumpur ...	...	77	
Negri Sembilan ...	Ulu Selangor and Ulu Langat ...	...	101	231
	All districts ...	...	...	
Pahang ...	Raub, Bentong and Kuala Lipis ...	...	19	30
	Kuantan ...	...	11	

Total average number of labourers was 235,156.

" " Indian " 161,068.



The distribution of labour was as follows :

			Indians.		Others.	Total.
Perak ...	{	Perak North ...	28,418	...	9,623	38,041
		Kinta ...	9,485	...	3,257	12,742
		Lower Perak and Batang				
		Padang ...	27,621	...	8,676	36,297
			65,524	...	21,556	87,080
Selangor ...	{	Bernam ...	1,649	...	1,063	2,712
		Ulu Selangor and Ulu				
		Langat ...	13,207	...	6,263	19,470
		Kuala Lumpur ...	9,414	...	2,431	11,845
		Coast ...	51,408	...	2,906	54,314
			75,678	...	12,663	88,341
Negri Sembilan ...	All districts ...		17,632	...	35,116	52,748
Pahang ...	{	Bentong, Raub and				
		Lipis ...	1,821	...	1,852	3,673
		Kuantan ...	442	...	2,872	3,314
			2,263	...	4,724	6,987
Total, F.M.S. ...			161,097	...	74,059	235,156

The table below sets out the mortality rates among estate labourers during the past ten years, that is, since the Health Branch took over the supervision of health conditions on estates :

Year.	Total number of estate labourers.	Deaths.	Death-rate per mille.
1911 ...	143,614	9,040	62.9
1912 ...	171,968	7,054	41.02
1913 ...	182,937	5,592	29.6
1914 ...	176,226	4,635	26.3
1915 ...	169,100	2,839	16.78
1916 ...	187,030	3,299	17.61
1917 ...	214,972	3,906	18.71
1918* ...	213,423	9,081	42.55
1919 ...	216,573	3,384	15.16
1920 ...	235,156	4,367	18.57

There were 3,881 deaths among the 161,097 Indian estate labourers during the year giving a mortality rate of 24.09 per mille :

Divisions.	Malarial admis- sions to estate hospitals.	Malarial deaths in estate hos- pitals.	Total admission to estate hos- pitals.	Total labourers employed a ll nationalities.	Total deaths.	Death-rates per mille.	Indians employ- ed.	Death Indian labour force.	Death-rates Indian labour force.	Number of estates.	Number of hos- pitals.
Kuala Lumpur ...	4,959	110	12,821	11,845	310	26.17	9,414	301	31.97	77	13
Pahang ...	2,195	21	5,642	6,987	136	19.46	2,263	61	26.95	30	9
Selangor ...	6,160	144	10,953	19,470	494	25.37	13,207	460	34.83	101	9
Coast ...	11,489	336	25,250	54,314	1,070	19.7	51,408	1,053	20.48	163	37
Negri Sembilan	11,942	210	27,185	52,748	963	18.25	17,632	742	42.05	231	45
Perak North ...	6,824	79	15,768	38,041	607	15.96	28,418	522	18.37	230	27
Kinta ...	2,274	37	5,782	12,742	177	13.89	9,485	169	17.82	119	8
Lower Perak ...	6,543	161	12,196	36,297	600	16.53	27,621	563	20.41	197	29
Bernam ...	112	1	563	2,712	10	3.61	1,649	10	6.06	8	2
	52,498	1,099	116,160	235,156	4,367	18.57	161,097	3,881	24.09	1,156	179

\* Influenza year.

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